AUG 30 1924

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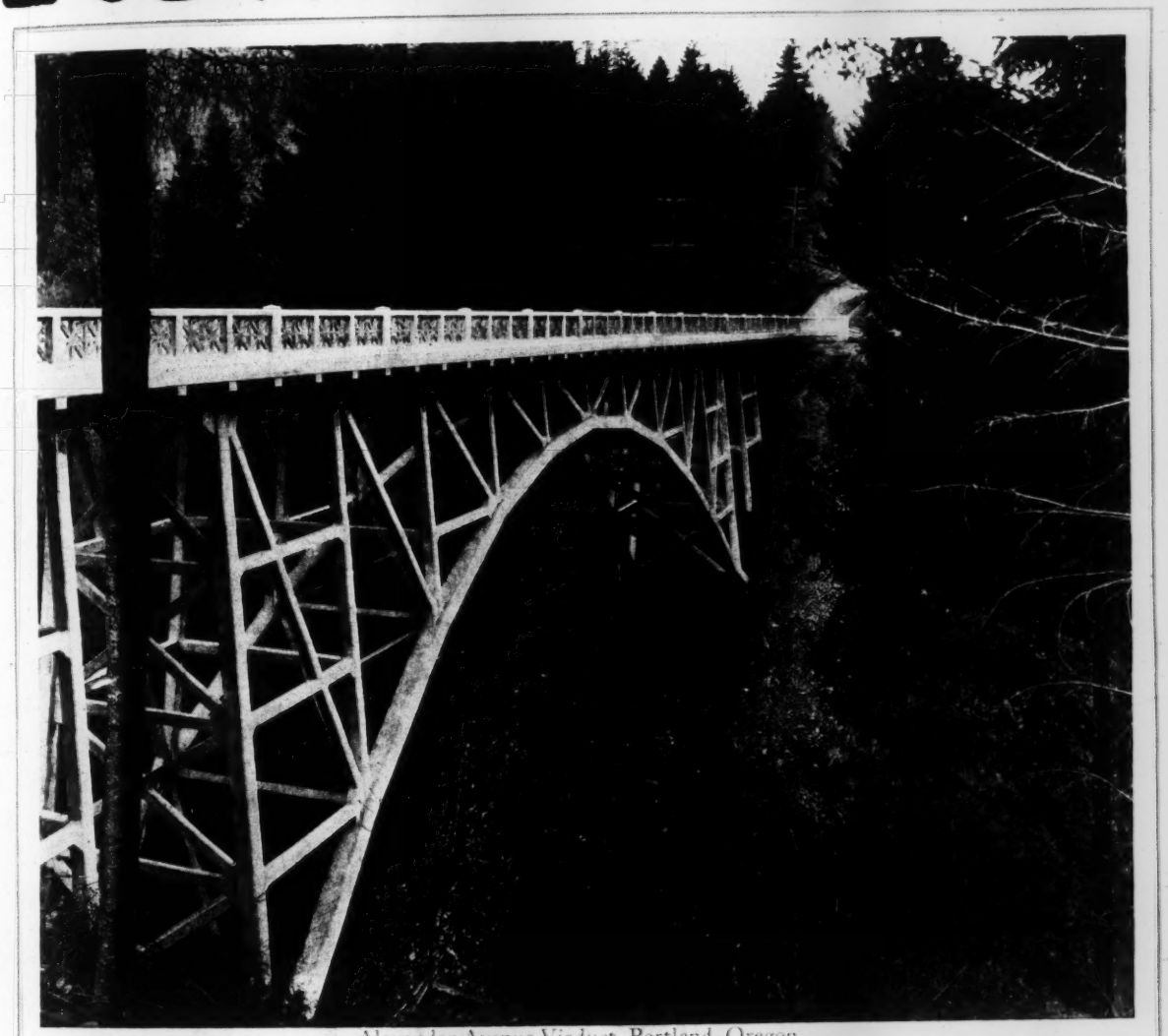
August 28, 1924

# Engineering News-Record



Alexander Avenue Viaduct, Portland, Oregon

## A Return to Checks and Balances and Decentralization

*Studies of the new Los Angeles city charter.*

## Personnel System for an Engineering College

*Details of the Purdue University experiment.*

## Unusual Concrete Bridge at Portland, Oregon

*A design based on economy, permanence and beauty.*

## Correcting the "Lean" in Aerial Photographs

*Harmonizing aerophotographs and field survey data.*

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# ENGINEERING NEWS-RECORD

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DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

FRANK C. WIGHT
*Editor*

Volume 93 NEW YORK, AUGUST 28, 1924 Number 9

## Expense Accounts

HIGHWAY department employees have "no official business outside of the state," at least so far as an expense account is justified, according to a ruling of the Attorney General of Kentucky. Therefore, a department employee sent to Washington to arrange for the state's pro-rata share in the distribution of surplus war material for state road work has had his expense account "held up." Possibly Kentucky has gone a step further in thus stopping traveling expenses at state boundaries than have other states, but there are few in which a policy so niggardly as to excite the derision of business men is not followed in reimbursing road department employees for expenses incurred in the line of their duties. And the federal government presents no better case in the treatment of its Bureau of Public Roads division heads who have to go about constantly and be absent for considerable periods in the conduct of their work. In all these cases, as in Kentucky, the interpretation of law may be absolutely precise but it is shortsighted law.

## Aggregate Study Useful

CHERT is a stone of rather limited occurrence so that its behavior as a concrete aggregate will interest only a few users of concrete. To them the studies by the Missouri State Highway Department noted on another page are of direct importance. To other engineers, however, the investigation is useful as indicating the possibilities of danger that lie in aggregate. We know far too little about the behavior of various concrete aggregates. There are standard tests, to be sure, and there are numerous investigations on specific stones and gravels, but all of this does not always make certain the safe use of some aggregates. There are peculiarities of behavior, such as the freezing failure of the Missouri chert or the absolute disintegration of the Indiana stadium (a failure yet to be fully described or explained) which seem obvious enough after the trouble has occurred but which foresight did not predict. An excellent field of research lies ahead in the study of the effect of aggregate on the life of concrete.

## Cincinnati and Kansas City

IN STRIKING contrast with the defeat of bonds for municipal improvements at Cincinnati on Aug. 12 was the approval of a larger bond issue at Cincinnati four days earlier. Although in each case the vote doubtless turned largely on the merits of the proposed improvements and the plan for financing them, distrust of the municipal administration at Cincinnati and confidence in the one at Kansas City seems to have contributed materially to the defeat of the bonds in the one case and their success in the other. The Cincinnati bond defeat was discussed in these columns last week. The points at issue in the Kansas City bond election were fewer and simpler than at Cincinnati. Three trunk sewer projects were up for approval in the Missouri city. Besides the apparent strong demand for the sewers an impelling motive for authorizing the Kansas City bonds was a desire to abandon the old plan, mandatory under the state constitution, of assessing the entire cost of trunk sewers upon the real estate within the districts served by the sewers, as stated on p. 315 of our issue of Aug. 21. The assessment was not on the benefit principle, judicially applied, but on the predetermined arbitrary method of making each square foot of land bear a pro rata share of the entire cost of the improvement—regarding which we have more to say in a later issue. The voters at Cincinnati and Kansas City showed a commendable discrimination in their defeat of bonds in one case and their approval in the other that deserves consideration in other cities.

## Gasoline Tax Diversion

DIVERSION of motor-vehicle tax funds to other uses than highway construction and maintenance is meeting a growing protest from motor-vehicle interests and state road officials. At present the laws of a number of states call for a division of gasoline tax money and license fees between highways and schools or place it in the general fund for state expenses. The justification of motor-vehicle taxation is that it is compensation for highway service. To devote it to other uses is felt to be iniquitous special taxation, particularly when, in the case of gasoline, the tax is remitted when the fluid is used for other purposes than vehicle operation on the highways. The motor-vehicle owner is now paying a considerable proportion of the cost of highways in special taxes on his vehicle and its fuel. In general he is doing this with commendable cheerfulness. Indeed he is contemplating without much protest the certain prospect of a rather general revision upward of his vehicle and gasoline tax rates. In view of this situation it seems high time that legislatures should revise laws which permit diversion of motor-vehicle tax funds to other purposes than road improvement.

## Sewerage Dominant

THE preponderance of papers on sewerage and sewage treatment at the London International Sanitary Engineering Conference, reported by Harrison P. Eddy in this issue, illustrates a curious tendency prevalent for decades past to limit sanitary engineering to sewerage and sewage disposal. This was brought out long ago by Baldwin Latham who used "Sanitary Engineering" for his treatise on sewerage. True, the term sanitary engineering is often broadened to include all that the words indicate but in many cases, when refuse disposal and plumbing are included with sewerage, there will be an omission of water supply. This may be due to the fact that water supply is so important that it stands in a class by itself. In England, where water supply seems to be classified as outside of sani-

tary engineering more often than in America, the journals that aim to cover municipal engineering—to use a term broad enough to include all the urban works and services under consideration here—have perhaps ten articles on sewerage and town refuse to one on water supply. Can it be that this is because water-supply practice has long been so much standardized there, while sewerage and particularly sewage treatment still abound here as unsolved problems? At the London conference there seem to have been only four papers on water supply and purification, against an equal number on refuse disposal and the same number on plumbing, whereas the program showed about fifteen on sewerage, including treatment, and ten on the activated-sludge process alone—strong testimony to the dominance of sewage disposal problems today and to the hopes and questions that center in this newer method of treatment after ten years of trial. In view of the prominence given to American engineers on the London program, it may seem presumptious to suggest that a place might well have been found for at least one paper on water purification in the United States and Canada; for, although water treatment problems are far different in Great Britain and considerably different on the Continent of Europe than in America, we believe a fuller knowledge of filtration and chlorination practice in the United States and Canada would benefit those countries, as also the few other countries of the world represented at the conference and the many unrepresented countries that will obtain and study the volume of Congress proceeding, mentioned in Mr. Eddy's report of the Conference, to be available in due time.

### Motor Vehicle Accidents

CAREFUL count for seven months of 1924 of motor vehicle accidents in Connecticut show an increase in number. Up to Aug. 1, there were recorded 10,264 accidents according to a bulletin of the Connecticut Department of Motor Vehicles. The same causes as of old are predominant. Recklessness of motorists, it is stated, was the cause of 5,929, or over half, of the accidents. Equipment defects are charged with only 537 accidents. Road defects are not listed as a cause if, indeed, they may have been at all contributary. About 61 per cent of all accidents occurred in cities. There are no figures given of the rate of accidents per vehicle or per vehicle mile. Lacking these the statement of numerical increase must be regarded with caution. It is presumable that the increase is accounted for by increase in traffic. At least until we learn more about the facts we cannot justly assume that increased number indicates increased recklessness and carelessness in operating vehicles and using the roads. Indeed the report implies that conditions in these respects if not improved are certainly no worse. In conclusion, interesting comment is made in the report as follows: "Certain organizations and especially the National Automobile Chamber of Commerce, through an analysis of traffic accidents gathered from newspapers, and including the State of Connecticut, intimate that motor vehicle fatalities are receding. Taken by yearly periods this is not apparently the case in Connecticut, but it is a fact that in Connecticut the months of May, June and July in 1924 compare favorably with the corresponding months of every other year."

## A Charter of Divided Responsibilties

IN CONSIDERING the remarkable document which on July 1, 1925, will become the city charter of Los Angeles, Calif., several things should be remembered. One is that through two decades of charter innovations in this country, Los Angeles has refrained from adopting either the commission or the commission-manager plan and has clung to the old system of checks and balance and divided responsibilities in municipal legislation and financial and administrative control; and having resisted thus long it is now ready to be caught by the tide of reaction and swept back further than ever into decentralization. Another thing to be expected is that in a large and rapidly growing city, with a population made up of people who have had experience with the many forms of municipal government that have been tried in this country, a conglomerate charter might be adopted.

Retrogressive in many ways as the Los Angeles charter is, it has a number of progressive features: the initiative, referendum and recall; a carefully designed even though much divided system of budget control; fairly comprehensive civil service provisions, although with rather liberal exemptions and the way made easy for letting down the bars. There is also a central purchasing bureau along progressive lines, with exemptions in some particulars for two or three administrative boards that will give rise to praise in some quarters and blame in others, but will meet with the approval of many experienced engineers.

The reactionary features of the charter center in divided responsibilities and decentralization. The old system of checks and balances prevails to such an extent that neither the mayor or council can be held responsible for appointments, legislation and the budget, while a large part of the budget is entirely outside the control of the mayor and council. Responsibility is further divided and decentralization carried to an extreme by the creation of nineteen administrative boards, five of which control their budgets—not counting the housing commission which except for general ordinances control, is a law unto itself. Sixteen of the nineteen boards are called "citizen boards." Each of these appoints a manager with powers in his department much like those of a city manager. None of the nineteen boards are under any direct central control except such as come from their being subject to appointment and removal by the mayor and council. The mayor cannot hold the members of these boards responsible, for his power both of appointment and removal is dependent upon the confirmation of the council. The council cannot hold them responsible because the initiative as to both appointment and removal is held by the mayor. It is true that voters at large have a certain measure of control over these and all other elected or appointed officers through the power of the recall, but this is a slow, cumbersome and costly method of control, requiring altogether in a place as large as Los Angeles action by scores of thousand of men and women. It is also true that the mayor and council have indirect control of ten of the sixteen "citizen boards" in question, which are subject to the "general budget," and that there may be some measure of ordinance control over some of the other six boards.

The theory on which provision for so many administrative boards is based appears to be that it is desir-

able to draft a large body of capable citizens into city administration and that the members of each board will be chosen because of their special fitness for their positions. How well this will work out in practice at Los Angeles remains to be seen. Decades of unsatisfactory experience with the multiplicity of uncorrelated and uncontrolled boards elsewhere gave rise to the commission and the commission-manager plans which Los Angeles is going as far away from as possible.

Budget control goes back and forth between the mayor and council. The mayor's budget not only is subject to reduction or elimination of any item by the council but that body may also increase any item or even insert new items. Although when the budget is returned to the mayor by the council he may veto the entire budget or any of its items, or reduce any item, his vote may be "overcome" by a two-thirds vote of the council. These things, combined with the further one that the mayor and council have no control whatever of the budgets of several boards, present a division of the control of the finances of the city that would hardly be matched in the old haphazard days of city government.

An anomaly in the charter is that while virtually unpaid "citizen boards" administer several departments in charge of important public works and utilities, the charter creates a paid board of public works and requires its five members to give all their time to the city.

The city engineer gets more recognition than he is given in some charters, or than is given to most of the appointive officers in this charter, but this is more from general legislative requirements than from recognition of his importance as an engineer and administrative officer. He is included among a relatively few appointed officials for whom the charter stipulates qualifications. But he is not put on the plane of the managers of the "citizen boards." On the whole the city engineer seems to be regarded as more of a hired man for the board of public works and the city council than a man responsible for important construction which involves large expenditures and upon which the comfort and convenience of the entire population of the city largely depends.

The permissive charter provision for the formation of boroughs is unique. The only instance of borough government in America is afforded by New York City, so far as charters or charter amendments in actual force today are concerned, although there is a vague provision for boroughs in legislation passed in Massachusetts, this year, applicable to Boston. These possible Los Angeles boroughs are designed to meet the peculiar conditions that have arisen through annexation of outlying territory. Beyond giving the borough advisory boards the power to call the attention of various departments of the city to borough needs, and providing such a body as has just been named, the boroughs do not seem to be granted many powers except the possibly doubtful ones of voting to tax themselves to a limited amount outside the regular city tax levy.

Altogether the new Los Angeles charter, while in so many ways a surprising document, promises not only to add to our many interesting experiments in municipal government but also to do what is after all the main function of a city charter—give the people of the city the sort of government they desire. Under this charter, the people of Los Angeles can, chiefly by giving proper attention to the selection of their officials, and in a lesser and more uncertain degree by resorting to the recall of officials and the initiative and referendum on local legislation, have as good government as they are willing to provide themselves.

## Shades of Izaak Walton

STREAM pollution does not seem to have troubled Izaak Walton if one can judge from his "Compleat Angler." Doubtless it existed in his day, but he seems to have been able to find waters free from it or he would have mentioned it when discoursing upon the trout, a shunner of polluted waters. Devotees of the rod and reel in America of late have been making a united stand against stream pollution as menace to their sport, through the Izaak Walton League and other organizations. No one can object to this if it is done within reason, but there are indications that the League, like other one-idea organizations and individuals, does not always conduct its campaign with due regard to reason or the rights of others, or with much understanding of what restrictive measures there is any chance of getting enacted, much less enforced.

Reasonable efforts of the Izaak Walton League or of men and women working singly to protect fish life from stream pollution are to be welcomed. These people will find, however, that the cities and manufacturing industries of the country have immense interests at stake which must be considered. Both the cities and industries have a legitimate claim upon any and all natural waters as a means of disposing of city sewage and manufacturing wastes so long as public health and comforts are not too seriously menaced.

Many as are the devotees of the rod and reel they are few compared with the populations of our cities and towns, the sewage from which must eventually get to water and few even compared with the employees of the shops, mills and factories of the country whose living depends upon the continuance of these industries without undue burdens being imposed upon them for the benefit of relatively few. All these things fishermen should take into account. They will gain far better and quicker results, as some of them realize, by co-operating reasonably with cities and industries than by attempting to put drastic legislation on the statute books which will never be enforced.

Moreover, the fishermen are in some respects more sinners than sinned against. They, together with hunters and campers and automobilists, are penetrating to the remotest points of our municipal water-supply areas and subjecting the water supplies of millions to the danger of a pollution far more serious than that which threatens fish and fishermen.

A number of states have created health, water supply, fisheries and game commissions, acting separately each for one class of interests; a few have consolidated these agencies to a greater or less extent. Pennsylvania has a joint board on which the various agencies concerned with one phase or another of water conservation are represented and the 1924 New Jersey Legislature made provision for a similar board. Other states, of which Illinois affords an example, are encumbered with several boards which do not and perhaps cannot work to a common end. Where various and conflicting agencies exist they should be consolidated or at least co-ordinated. The Isaak Walton League and all others concerned in water protection and utilization will do well to join brains and heart to the same end.

# Unusual Spandrel-Braced Arch Bridge Built at Portland

## Dead-Loads Reduced by the Use of High-Strength Concrete and Short-Span Floorbeams—Trestle Used as Falsework in Constructing the Arches

By O. Laurgaard
City Engineer, Portland, Ore.

LOCATED in a sparsely settled part of the city of Portland Ore., where the value of the property on which its entire cost was to be assessed was low, the Alexandra Ave. bridge of necessity had to be designed so that it could be built with the utmost economy consistent with the requirements for permanence and pleasing appearance. As the sides of the gulch over which it was to be built provided good foundations for an arch, a type of spandrel-braced arch was used which, it is believed, is a radical departure from ordinary bridge construction. No record of any similar bridge has been found either in this or in foreign countries.

*Preliminary Arch Design*—The first step in the design of the arch, after an examination of the site showed that sound rock at both sides of the valley made

FIG. 1—COMPLETED ALEXANDRA AVE. VIADUCT, PORTLAND, ORE.

such a structure desirable, was the determination of allowable concrete stresses, by actual tests, with the idea of using high stresses in order to reduce the dead-load. For these tests nine cylinders of 1:1:2 concrete, 6 in. in diameter and 12 in. long, were cast, using different sands and gravel. These cylinders were broken at 7- and 28-day periods. The average crushing strength at 7 days was 2,610 lb., while at 28 days it was 4,140 lb. From this it was determined that a working stress of 900 lb. per square inch for concrete was safe. Subsequent tests, made during construction, were even better than the preliminary laboratory tests, the average for 7 days being 3,180 lb. per square inch and for 28 days 5,390 lb. In the 28-day tests some of the samples went beyond the limit of the testing machine without breaking, so that the average was probably considerably greater than the amount given.

The bridge as finally designed consists of a 150-ft. parabolic arch with a 35-ft. rise and ten 15-ft. panels, two 60-ft. approach trestles of four 15-ft. panels each, and two 11-ft. abutments, a total length of 292 ft. The roadway is 16 ft. wide and the single walk 4 ft. wide. In order to reduce the load of the floor system, the longitudinal trusses were placed 12 ft. apart with a portion of the roadway cantilevered on one side and the sidewalk cantilevered on the other. The floorbeams were spaced 5 ft. apart.

For the floor system design a live-load was used equivalent to a 12-ton truck with 3,000 lb. on each of the front wheels, and 9,000 lb. on each of the rear wheels, and wheelbase 6x12 ft. For the trusses a uniform panel live-load of 12,500 lb. and a snow load of 4,500 lb. was used.

Wind loads are carried along the top chord and down the end posts by a diagonal system in the end panel. In the lower chord the wind loads are carried to the abutments by a system of struts and diagonals between the arches.

The dead-load stresses were computed for three-hinged condition, the center hinge being left open until the span came to rest under dead-load, and being then sealed in. The live-load stresses were computed for two-hinged condition. In constructing the deformation diagrams the entire roadway slab was taken as part of the top chord and ten times the area of the reinforcing steel added to the concrete cross-sectional area. After the first preliminary design was completed, with the necessary changes made in sizes of members and reinforcing steel, a complete recheck was made and stresses were recomputed.

Under stress reversal due to temperature, wind and live-load, the compression in the diagonals was very small. As the tension stresses are taken entirely by the reinforcing steel, care was used to extend the rods into the top chord and the arch ribs far enough to develop their whole strength in bond.

The reinforcing rods in the lower chord were machined on the ends and butted together. In that way they were continuous from hinge to hinge, splice bars and clips being used to hold them in alignment. At the center and abutment hinges the rods fitted tight against the hinge castings. Care was used at the joints of the members to see that they were well reinforced with ties in all directions, so that the stresses would be carried through the joint and transmitted to the other members in the proper manner.

*Construction*—An old timber trestle on the site of the new viaduct was used as falsework for the arches. The old posts were cut off at the bottoms, where rotted, and cribbing constructed to obtain a solid foundation. A few new bents had to be built at the ends on account

TABLE—COST DATA OF CONSTRUCTION OF VIADUCT

| | Amount | Unit Price | Total |
|---|---|---|---|
| Excavation, common | 49 cu.yd. | $3.86 | $189.20 |
| Excavation, rock | 56.1 cu.yd. | 6.30 | 353.60 |
| Embankment and backfill | 70 cu.yd. | 1.14 | 79.75 |
| Falsework | | | 1,774.87 |
| Arch abutments and footings | 68.7 cu.yd. | 14.83 | 1,018.82 |
| End abutments | 56 cu.yd. | 14.82 | 829.92 |
| Arches, columns, struts and diagonals | 113 cu.yd. | 48.95 | 5,531.35 |
| Deck and girders | 160 cu.yd. | 19.90 | 3,184.00 |
| Handrail | 610.1 n.ft. | 3.84 | 2,342.40 |
| Miscellaneous | | | 1,290.90 |
| Reinforcing steel in place | 75,500 lb. | .456 | 3,442.80 |
| Steel castings in place | 6,500 lb. | .15 | 975.00 |
| Total cost from data | | | 21,712.61 |
| Total of engineer's estimate | | | 24,845.00 |
| Total of contractor's bid | | | 21,200.00 |
| Total of final estimate | | | 23,265.20 |

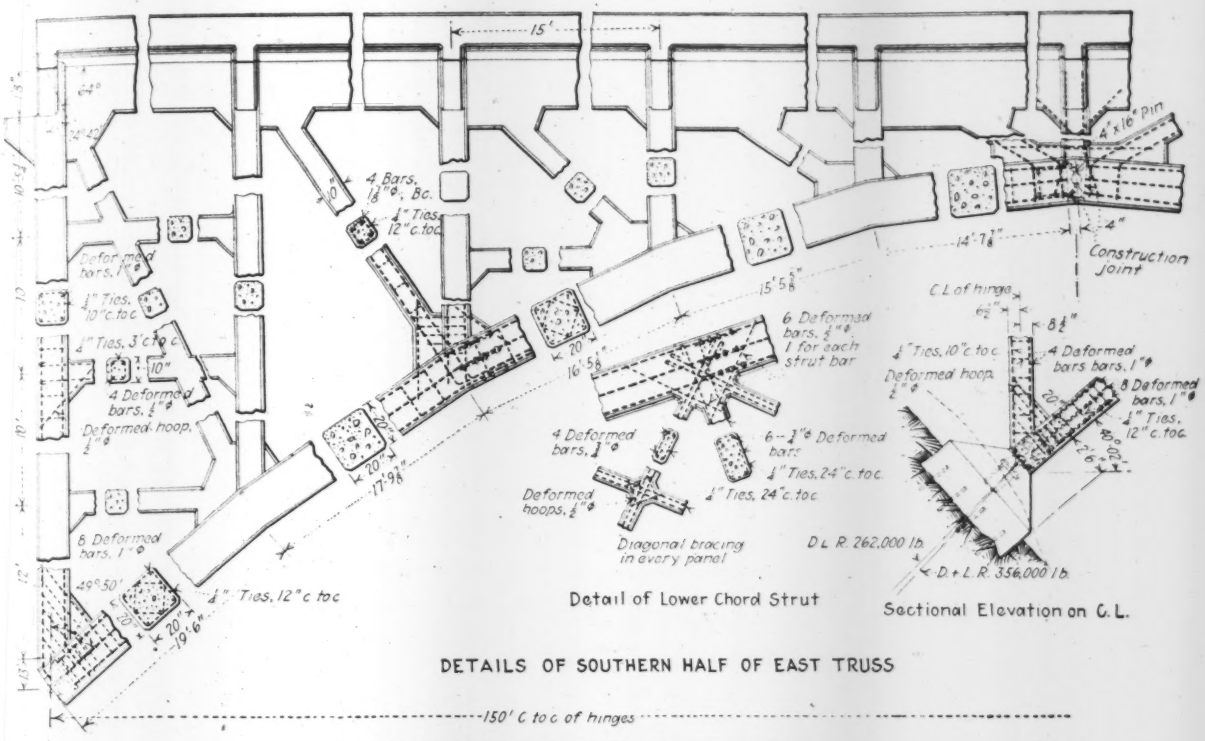

15'
4 Bars, 1⅛" ø, Bc.
¼" Ties, 12" c. to c.
Deformed bars, 1" ø
¼" Ties, 10" c. to c.
¼" Ties, 3' c. to c.
4 Deformed bars, ⅞" ø
Deformed hoop, ⅜" ø
8 Deformed bars, 1" ø
¼" Ties, 12" c. to c.
4' x 10" pin
Construction Joint
C.L. of hinge
6 Deformed bars, ⅞" ø, 1 for each strut bar
4 Deformed bars, ⅞" ø
Deformed hoops, ⅜" ø
6 — ⅞" ø Deformed bars
¼" Ties, 24" c. to c.
Diagonal bracing in every panel
D. L. R. 262,000 lb.
D. + L. R. 356,000 lb.
4 Deformed bars bars, 1" ø
8 Deformed bars, 1" ø
Detail of Lower Chord Strut
Sectional Elevation on C. L.
DETAILS OF SOUTHERN HALF OF EAST TRUSS
150' C to c. of hinges

FIG. 2—DETAILS OF ARCH AND SPANDRELS

of the spacing of the old bents. This method made a considerable saving in cost to the contractor. The stability of the falsework was demonstrated by the small settlement which occurred during the pouring of the concrete.

Excavation for abutments and footings had to be carried to a considerably greater depth than originally estimated on account of the broken structure of the rock. The abutments and footings were enlarged to fill the openings made in reaching sound rock.

Forms for the arch ribs with their struts and diagonal braces were first built upon the falsework. After this was completed the reinforcing steel for the arch ribs was placed. This reinforcing was built up in units for each panel length and then placed in position.

Next the reinforcing steel for the arch struts and diagonals was placed. This steel, owing to difficulty in placing in units, was placed one bar at a time.

Due to the fact that the reinforcement in the verticals and diagonals was continuous and extended a considerable distance into the arch ribs, this reinforcement had to be placed in position before any concrete was poured. The forms for these verticals and diagonals were constructed in units and placed in position to act as a support for the reinforcing steel. These forms were, in some cases, only skeleton forms and

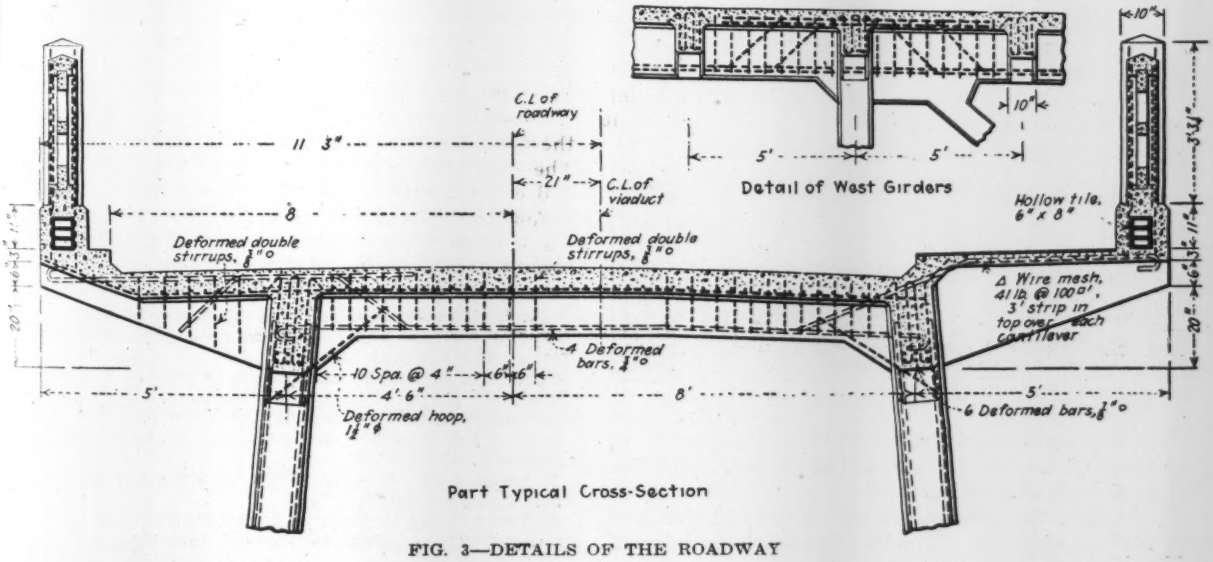



FIG. 3—DETAILS OF THE ROADWAY

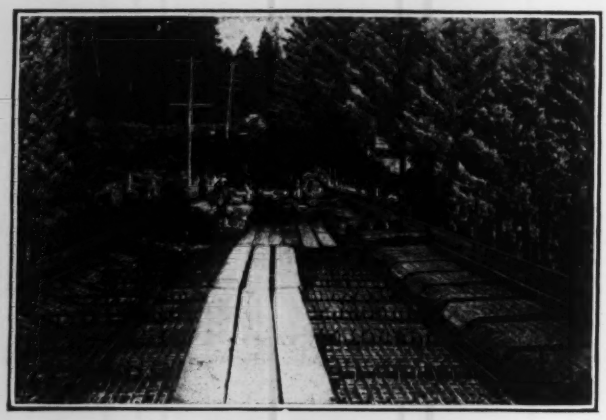


FIG. 4—ROADWAY DURING CONSTRUCTION

were completed later. In all cases one side was left open to be boarded up as the concreting progressed.

After all necessary forms had been built and all the reinforcing steel placed that in any way affected the arch ribs, the concreting was started. Two one-sack mixers were used but as the mix was 1:1:2 two sacks of cement were used to a batch. Concreting started simultaneously at each abutment and progressed toward the center hinges; the pouring of struts and diagonal bracing being carried forward at the same time. This operation was continuous, requiring eight hours' time; a total of 601 sacks of cement was used, which with a 1:1:2 mix gave a volume of 167 cu.yd. The verticals and diagonals were poured up to the top of the gussets at the same time as the arch ribs.

The vertical and diagonal members and the deck were poured at a later date. Construction joints were bulkheaded where vertical, and, in the roadway slab, were placed where the least shear would occur. The concrete at horizontal joints was roughened and sprinkled with neat cement before fresh concrete was poured.

FIG. 5—VIEW SHOWING METHOD OF BRACING

The pouring of the whole structure was carried on in such a manner as to balance the load on the falsework as much as possible.

Great care was used in placing all the concrete and few cavities occurred. These were chiseled out to leave a clean opening and were then filled with a dry mix 1:2 mortar pounded in with a block and maul.

The handrail panels were precast with 1:2 mortar, using a dry mix which was well tamped into the forms. These panels were placed between the main posts and the top rail, with intermediate posts poured in place.

*Cost Data*—Unit costs were obtained from actual checks made by the city. The following units were used: Cement $3.30; sand $2.45; gravel $2.70; form lumber $20; reinforcing steel $0.03½; laborers $5.40; carpenters $7.20; steel men $7.20. Complete construction costs are given in the accompanying table.

The bridge was constructed by the city of Portland, under management of the Department of Public Works, of which A. L. Barbur is commissioner. It was designed and constructed under the author's general supervision by F. T. Fowler, bridge engineer, and R. E. Kremers, chief of the bureau of construction. Lindstrom & Feigenson, Portland, were the contractors.

# Personnel System for a College of Engineering

## Details and Experience of Purdue University with System Developed with Funds Provided by Manufacturers

By A. A. Potter

Dean of Engineering, Purdue University, Lafayette, Ind.

A PERSONNEL system for the benefit of engineering students has been in use at Purdue University for several years. The most conclusive proof of the importance attached by industry to this system is that the initial funds for carrying on this work were donated by the Indiana Manufacturer's Association, which has contributed during the past three years $6,000 to develop it. Details of the system follow.

To freshman engineering students are explained the aims and workings of the system early in the year. Early in March of their freshman and junior years the engineering students are requested to fill out two forms. Form 1 includes data concerning the date and place of birth of the student, what studies he enjoys most, part taken in student activities, hobbies, if any, practical experience before coming to Purdue and during the vacations and information as to whether the student has ever planned, designed or built a new object.

In Form 2 the student is requested to give the names of fifteen or more references who know him best. These references must be selected from three groups, including teachers, fellow students and acquaintances (other than relatives) outside of the university.

In Form 3, sent by the dean of engineering to every reference, the people selected by the student are requsted to give information concerning character, personality and physique. Instructions are as follows:

Please use the scale 5 to 1; 5 is the highest grade obtainable and means perfection. If he is above average in any characteristic rate him 4, 3 means average, 2 means below average and 1 means poor.

Grade the student in comparison to men of similar age, educational preparation and environment. An effort has been made to define each of the characteristics in the following list in order that greater uniformity of rating may result.

1. Address and Manner (Does he leave a good impression? Is he popular?) . . . . . .

2. Attitude (Is he rational in his views? Interested in his work? Optimistic? Persistent? Self-controlled?). .

3. Character (Is he reliable? Dependable? Absolutely honest? Loyal? Responsible? Clean? Just? Courageous?) . . . . . .
4. Co-operative Ability (Can he work with others? Is he accommodating? Willing to learn? Tolerant? Tactful?) . . . . . .
5. Disposition (Is he cheerful? Courteous? Enthusiastic and not conceited?) . . . . . .
6. Industry (Is he a hard worker and has he perseverance?) . . . . . .
7. Judgment (Has he common sense? Observing and reasoning power? Foresight? Resourcefulness?) . . . .
8. Initiative (Is he a self-starter? Does he recognize and develop opportunities to a successful conclusion? Is he practical?) . . . . . .
9. Leadership (Does he understand men and can he command their respect?) . . . . . .
10. Mental Caliber (Is he accurate, systematic, alert? Has he knowledge of facts and data? Can he concentrate? Does he learn readily?) . . . . . .

*Tests and Rating of Students*—Some form of intelligence test is given to every freshman engineering student during the early part of the year. During the past two years these included the Purdue English Test and the Scott Mentality Test. The former, requiring 35 minutes, includes punctuation, grammar, choice of words, literary information, spelling, vocabulary and reading. The Scott Mentality Test is in five parts and about 20 minutes were allowed for this.

At the end of the junior year the heads of the four engineering schools at Purdue, with the assistance of the members of their staffs, rate each junior engineering student on knowledge of fundamentals and general technique and state the work for which he is best adapted.

The opinions of the teachers concerning the work for which a student is best qualified are checked by the student's own choice as indicated on an employment information blank he turns in. The main questions are as follows:

What branch of engineering would you like most to enter upon graduation? Underline your choice in the following list: Sales, production and management, design, construction, power generation and distribution, research, communication, transportation, public service work, manufacture of gas or chemicals, public utilities, teaching.

If the branch of engineering in which you are most interested does not appear on this list, please write it here (and space is left for this purpose).

If not interested in taking up engineering or work closely related to engineering, what branch of business would you prefer to enter?

Have you a satisfactory position in view which you intend to accept upon graduation?

The data collected are averaged and entered on a 5x8 card which is the permanent personnel record kept in the office of the dean of engineering. It includes also the student's photograph, results of intelligence test, academic record (grades received), honors awarded, faculty or committee action and similar information which is of value for permanent record.

Upon request the students are given copies of their personnel records. They are also referred to members of the engineering staff for confidential interviews of advice and help if the ratings show that they are below average in any of the important characteristics.

Great importance is attached to these interviews and those who act as advisors are chosen from the engineering staff with great care.

The student of superior attainments is encouraged by giving publicity to his achievement. A survey of the academic records of all engineering students is made at the end of every semester. Scholarship is stimulated by sending letters to the parents, high schools and town papers of students who rank in the upper tenth in their studies.

The responses received from parents, high school principals, students and newspapers indicate that this type of publicity is one of the most valuable phases of the Purdue personnel system.

Finally, employers are asked questions as to character, personality and physique, to follow up the engineering graduates. The results of the follow-up letters are communicated in a tactful and confidential way to the alumnus.

*Maintenance and Benefits of System*—The cost of the system for a college which has 1,800 engineering students is $5,000 per year. This includes clerical help, printing, postage and the salary of a part-time personnel assistant to the dean of engineering, but it does not include the time of the dean of engineering or of the members of his staff who interview students. About $5 per student per year will probably cover the entire cost in the case of a college of 1,800 students.

The benefits indicated may be summarized as follows:

The personnel system encourages self-analysis on the part of students and provides an incentive for self-improvement. A student making out Form 3 for several of his classmates cannot help but reflect about his own characteristics.

The personnel records and interviews have been helpful in pointing out to a student his deficiencies and in impressing him with the fact that good qualities of personality can be developed by observation, self-analysis and by constant effort.

The personnel system, in combination with the student's grades, has been of considerable value in discovering the student's talents. It is hoped that the system will eventually prove quite accurate in guiding students in the selection of their career.

The personnel records have been of utmost value in recommending engineering students for positions. During the past two years the employers of engineering graduates have been making much use of the system in selecting engineers to meet certain specifications. Letters have been received by the university from many of the most prominent employers of engineers commending the system in bringing the man and the job together.

The publicity which has been given to the work of students who excel in their studies has had a tendency to stimulate scholarship and to improve the social status of the outstanding student.

## Britain's Greatest Hydro-Electric Scheme

The first contract has been placed for the Lochaber hydro-electric scheme in Scotland, the largest of its kind ever undertaken in Great Britain. The scheme is government-assisted, the "trades facilities guarantee" amounting to two million pounds, sterling, out of the total cost of five million pounds. The present neighborhood is virgin forest, and the scheme is planned to supply power for a number of aluminum and other metal plants to be established in the vicinity. Part of the scheme involves tunneling for 20 miles through Ben Nevis. One tunnel is to be 18 ft. in diameter, and the other large enough to accommodate a broad-gage railway track. The scheme involves the construction of dams, spillways, concrete intakes, and the damming of Lochs Treig and Laggan and of the Treig, Spean, and Spey rivers.

# Chert Unfit for Coarse Aggregate in Concrete

## Experiments and Tests in Missouri Highway Work Show Chert Causes Decomposition in Surface After Freezing

By F. V. Reagel
Engineer of Materials, Missouri State Highway Department, Jefferson City, Mo.

During the construction season of 1923, a peculiar surface effect was noticed by the writer in connection with concrete pavements constructed in certain localities in the state of Missouri. The effect noticed was a semi-circular or half-elliptical crack averaging about 1 in. to 1½ in. in diameter. Investigation developed that portions of the surface of the shapes and size stated were cracking loose from the pavement and could be pried out or were later displaced by traffic, leaving a hole with sloping sides from ½ in. to 1 in. in depth. On removal of a large number of the "pop-outs," it was discovered that the piece of pavement loosened always contained a part of a piece of chert aggregate while the other portion of the piece of aggregate was left forming the bottom of the hole in the pavement. In other words, the force acting to raise the "pop-out" occurred in all cases through the aggregate. In no case did the action occur in connection with pieces of limestone, of which the greater part of the coarse aggregate in the pavement consisted, but always occurred just over and through a piece of the chert which occurs as an impurity in the limestone.

An investigation was immediately started with the purpose of determining the cause of the action and its extent as regards both the surface effect and the reduction of the strength of concrete. While the series of tests has not at this time been entirely completed, especially as regards the percentage effect on concrete strength of varying quantities of chert present in coarse aggregate, yet the surface effects noticed on pavement work have been duplicated under control and enough information has been obtained to definitely assign the cause and to justify the exclusion of the undesirable impurity by specification.

As established by the investigation, the effect is due to frost action on particles of chert such as occur in nodular or sheet formation in the various limestone formations. No action is apparent in connection with the flint obtained from crushing lead and zinc ore but very serious effects are found in connection with the crushed chert found in crushed limestone from any of the various limestone formations thus far investigated.

*Definition of Terms*—It has been customary to use the terms, chert and flint rather generally without attempt to distinguish between materials which have distinctly different physical characteristics. In order to avoid confusion, on the part of the reader, a brief statement of the geology of the material in question would probably not be out of place.

While it is common practice to use the terms flint and chert synonymously, they have been distinguished from each other (Missouri Bureau of Geol. & Mines Bull., Vol. II, Second Series, p. 337, and in "Quarrying Industry," by Buckley and Buehler) in the following manner:

"Strictly speaking, chert is a variety of hornstone which resembles flint, but having a more splintery fracture and being more brittle."

It may be well to state here that flint has a conchoidal fracture with sharp edges, and an undulating surface, similar to that exhibited by the edges of a piece of broken glass.

Flints and cherts are composed of silicon and oxygen in the form *of* $SiO_2$, and are cryptocrystalline varieties of quartz. Flint is very closely allied to that form of quartz known as chalcedony. In addition to silica, cherts and flints very often contain some carbonaceous material and iron compounds which have the effect of producing gray or black shades.

*Origin of Flints and Cherts*—Whether or not cherts are of primary or secondary origin has never been definitely decided upon, although it is very reasonable to believe that they are derived from both sources.

Those of primary origin are probably the result of the consolidation of siliceous slimes or oozes which were chemically precipitated from sea waters. Also it is possible that they were originally formed through the medium of sponges, oolites or other organisms capable of secreting or surrounding their bodies with silica. The latter form the nuclei for larger chert nodules.

TABLE I—COMPRESSIVE AND RUPTURE STRENGTH

| | Compressive Strength 28-Day Lb. per Sq.In. | 90-Day Lb. per Sq.In. |
|---|---|---|
| Compression (unfrozen) | 3,507 | 5,765 |
| Compression (frozen 5 times) | 1,612 | 2,870 |

Modulus of Rupture—28 Days

| Unfrozen | | Frozen | |
|---|---|---|---|
| 12-in. Span | 24-in. Span | 12-in. Span | 24-in. Span |
| 810 | 886 | 153 | 88 |

Modulus of Rupture—90 Days

| Unfrozen | | Frozen | |
|---|---|---|---|
| 12-in. Span | 24-in. Span | 12-in. Span | 24-in. Span |
| 1,132 | 1,032 | 190 | 161 |

These may also be considered as cherts of secondary origin, inasmuch as the original nodules may have been of minute size and their growth has been due entirely to accumulation from silica-bearing ground waters.

Some of the nodules may also have been formed in the limestones or dolomites at that point where the silica-bearing ground waters have come into contact with other ground waters carrying carbonic or humous acids. This would result in the precipitation of the silica and further growth of the nodule would be dependent on the continuation of this process.

It is also possible that the precipitation of the silica could be caused by the presence of some mineral such as partially decomposed pyrite. This mineral would form a nucleus around which a nodule of good size could gradually be formed.

*Distribution, Occurrence and Characteristics*—While cherts occur in most of the limestone and dolomite formation found in the state of Missouri, it is with those occurring in the Burlington limestone of the Mississippian system that we are mostly concerned.

This formation is quite extensive in the southwest and northeast portions of the state, these localities being joined by a comparatively narrow strip of the Burlington limestone that runs diagonally across the state.

Because of its great thickness of almost pure limestone and its wide distribution, many of the large quarries and cement plants secure their raw materials from this formation.

The cherts found in the Burlington formation occur as well defined beds between two limestone members and as irregularly placed nodules found within the lime-

stone beds themselves. In most cases, and especially in those occurring as nodules, a strong concentric banding is noticeable. This banding is due, no doubt, to the periodic deposition of the silica from percolating waters.

When first exposed in quarry faces and cuts, the cherts appear to be very hard, compact and fairly homogeneous. However, they soon begin to show signs of alteration along the edges, showing a marked tendency to become chalky. If the chert is exposed to the freezing and thawing action of the winter weather, it will break up into smaller fragments. This is due to the expansion of the freezing water that has gained access to the interior of the chert through or along fracture planes that are unnoticeable to the naked eye.

TABLE II—SCREEN ANALYSIS

| | Hard Gray Undecomposed Chert | | Partially Decomposed Chert |
|---|---|---|---|
| | Test 1 | Test 2 | |
| Original No. Pieces | 11 | 18 | 13 |
| | Per Cent | Per Cent | Per Cent |
| Passing 1½-in. screen | 21.0 | | 65.6 |
| 1¼ | 14.0 | 34 | 63.0 |
| 1 | 6.9 | 24 | 49.5 |
| ¾ | 3.5 | 14 | 33.0 |
| ½ | 1.9 | 7 | 22.1 |
| ⅜ | 0.7 | 2 | 7.5 |

As shown by a number of trials, flint is not seriously affected by freezing action.

Experiments tend to prove that the effect on chert is confined to material which has not had an opportunity to be resilicified. Gravel formed by stream action from chert material has been subjected to the action of iron and silica compounds and in most locations in Missouri has been completely stained to a brown color. In all cases investigated the stained gravel successfully resisted attempts made to induce disintegration by freezing. The difference in resistance to freezing effects noted between crushed chert on one hand and crushed flint and stained chert gravel on the other is attributed by the writer in a large measure to the resilicification of the flint and the chert gravel.

The effects as observed on concrete containing chert aggregate are serious both as to the appearance and the strength of the work. Whenever a piece of the chert has a position in the concrete near enough to the surface to be readily subjected to the freezing and thawing action of a winter season, the resulting expansion ends in radiating cracks as well as spalling and the pop-outs mentioned above. The final result is a considerable weakening of the concrete in pavement or structure. In case the entire coarse aggregate content of the concrete is the chert mentioned, a sufficient number of cycles of freezing and thawing will result in a virtually complete disintegration of the concrete as rapidly as the progressive disintegration exposes fresh surfaces of the structure to the weathering effects. The presence of small quantities of the chert in the coarse aggregate results in a varying amount of surface effect and strength reduction. The deleterious effect has been verified by both laboratory test and field observation and action has been taken by the Missouri Highway Department limiting the percentage of the objectionable material to 5 per cent of the coarse aggregate by volume.

Some of the average results of the investigation are given in Table I. The scope of the investigation is considerably broadened and is being continued to include other materials.

*Test Data*—Averages for 6x12-in. compression specimens and 4x6x24-in. transverse specimens broken with both 12- and 24-in. spans are given at 28-day and 90-day ages. The mix used was a 1:2:3½, using a slump of ½ to 1 in. Cement and sand meeting the Missouri state highway specifications and passing standard tensile test requirements were used. The coarse aggregate was crushed chert. Some individual transverse specimens broke under their own weight and some compression specimens were so badly disintegrated that no compression test could be made after they had been subjected to five alternations of freezing and thawing. Specimens were not subjected to freezing until they had reached the ages indicated.

CHERT AGGREGATE CONCRETE AFTER FIVE TIMES FREEZING

All specimens were free from cracks and surface defects and showed comparatively smooth surfaces before freezing.

In addition to the freezing tests made on concrete in which the chert was used as aggregate, samples of the chert itself were subjected to the same tests. It may be noted that the chert occurs in the rock formations in various stages of disintegration, varying from a hard dense gray chert, breaking with conchoidal fracture and sharp edges to a white or stained amorphous material which can be crumbled with the hands.

The freezing tests were made on a number of samples covering varying stages of the disintegration, and it was found that all forms of the chert were very seriously affected by the freezing action. The chert which was in the more advanced stages of disintegration was the more seriously affected and would be the most objectionable in concrete. In the freezing tests of the aggregate, a number of pieces of the hard gray chert all retained on the 1½-in. round screen were selected, care being taken to select pieces which to visual inspection were free from separation planes or incipient cracks. Pieces were also taken of the partially disintegrated material which was in a medium stage of disintegration and were still a hard material. These specimens were subjected to five alternations of

freezing and thawing and the amount of disintegration is indicated by a screen analysis of material after test. All pieces were retained on the 1½-in. round hole screen and passing the 2-in. sieve. The results of the screen analysis after test are given in Table II.

A study of the above results shows the extent to which the material is affected by as few as five alternations of freezing and thawing. There would ordinarily be many more than this number in an average winter season. Examination of existing pavements and structures confirms the results obtained in the laboratory and proves very conclusively that the objectionable material should be limited to the smallest percentage possible if good results with concrete made from coarse aggregate containing chert as an impurity are to be obtained.

The illustration shows a typical surface effect obtained after freezing beams five times. The beam was smooth and free from defects before exposure to freezing.

# South Dakota Drainage Ditches With Flood Gates

## Country with Slight Fall but Subject to Floods Complicates Drainage Problem—Diked Channel Through Big Slough

By Paul S. Egbert
County Engineer, Aberdeen, So. Dak.

DIFFICULT outlet conditions which presented serious problems in the drainage of sloughs and wet lands in the Portage, Detroit & Crow Creek Drainage District, of South Dakota, included a very slight fall, much slough land and a back-water of spring floods which necessitated the installation of flood gates. The land is slightly rolling, with a maximum difference in elevation of not more than 25 ft., and there is little fall in the draws and in the few streams, while there are many pot-holes and sloughs with no outlets. The average annual rainfall is about 26 in.

This district provides for the drainage of about 95,000 acres by 46 miles of main ditch, of which the bottom depth is 18 ft. for 20 miles, 12 ft. for 2½ miles and 6 ft. for 23½ miles. The depth of cut is from 2 to 22 ft., and in the larger ditch the depth of water is about 3 ft. A plan of the district and ditch layout is given in Fig. 1, with typical ditch and levee sections in Fig. 2. The area of the district comprises two distinct sections with widely different runoff conditions. That part of the ditch north of the junction with Crow Creek, which comes from the east about 10½ miles south of the North Dakota line, was designed primarily to connect a series of large and small sloughs in the most economical way and to take advantage of such fall as was available. The second section, extending to the outlet, follows along the channel of Crow Creek and includes widening, deepening and straightening this channel.

This part of the country has a general drainage southwest to the James River, but the district under consideration had only two outlets, one to the James River west of Hecla, South Dakota, and the other to Crow Creek, south of Hecla. It was found, however, that the sloughs east of Hecla were 4½ ft. below the average stage of the James River, so that a river outlet was not possible at this point. It appeared then that the only practicable outlet for drainage water was by Crow Creek, a small sluggish stream flowing southwest from its source near Britton to its junction with the James River near Tacoma Park.

The utilization of this stream as an outlet for the north sloughs presented some difficulties. In the first place, on account of the slight fall the channel in many places was not even discernible. It was considered necessary, therefore, to construct a large ditch through the entire length of Crow Creek, affording a channel for drainage water from the north and also improving conditions along the stream by draining a number of sloughs through which it passes.

At its lower end, the stream spreads out into a large slough about five miles long and a mile wide, just

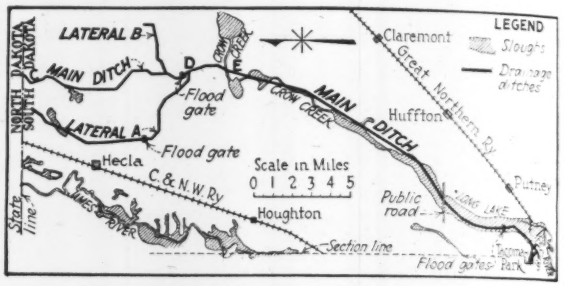



FIG. 1—DRAINAGE DISTRICT AND DITCHES

north of the James River and with its bottom in many places below the level of the river bed. This difficulty was overcome by constructing a channel along the west side of the slough and along the base of the bluffs to the river. To prevent the drainage water from flooding the slough, a dike was built parallel with the channel and preventing any overflow (see Fig. 2). During the low-water period of 1923, the water in the slough was reduced to a maximum depth of about 2 ft., and from the writer's experience it is judged that in a year or two evaporation will dispose of all remaining water in the slough, now that no outside water can reach it.

A heavy cut through an elevated table land is required for two miles north of Crow Creek, where the creek swings from east to a southeast direction, in order to connect the northern sloughs with the creek. Here the maximum cut is 22 ft., with a 12-ft. bottom and slopes of 1 on 1½, requiring the excavation of about 156,000 cu.yd. The material was placed on both sides of the cut, leaving a berm of 8 ft. Side slopes of 1 on 1 for the entire length of ditch were planned originally, but after construction had started it was considered advisable to change them to 1 on 1½ owing to soil conditions. North of the big cut the soil is composed of sand with 20 to 60 per cent of clay. In the big cut the clay content averaged 35 per cent, but as any obstruction in this part of the ditch would block the entire north drainage system the 1 on 1½ slope was adopted for this cut also.

*Lateral Ditches*—The land included in this district has a general slope to the southeast and the main ditch and lateral *B*, flowing south, have a good fall, considering the general flat topography. Thus the main ditch has a fall of 15.4 ft. in its length of 31.6 miles, or nearly 6 in. to the mile. Lateral *B*, with a length of 3.2 miles, has a fall of 10.8 ft., or about 41 in. to the mile.

Lateral *A*, flowing southeast, is very flat for its entire length of 10.8 miles, but it was included in the original

project for the reason that many of the strong petitioners for the drainage system lived along the line of this lateral. A year ago the writer recommended that it should not be constructed, but in spite of its bad features the petitioners insisted that the work should be carried out. This lateral will serve as a drain only in years of exceptionally high water, when the James River overflows its banks and finds its way into these sloughs, causing a rise of about 6 ft. In ordinary years the lateral will serve only to equalize the water level in the sloughs along its course.

*Flood Gates*—Another difficulty was presented by the James River, which normally rises about 6 ft. in the spring and would back up water in the ditch or channel.

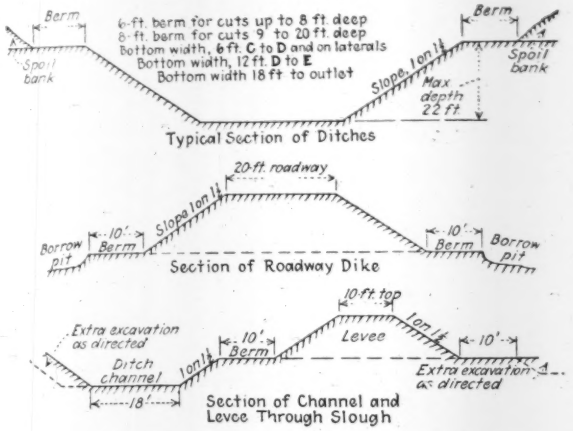

Berm
Spoil bank
6-ft. berm for cuts up to 8 ft. deep
8-ft. berm for cuts 9' to 20 ft. deep
Bottom width, 6 ft. C to D and on laterals
Bottom width, 12 ft. D to E
Bottom width 18 ft. to outlet
Slope 1on1½
Max. depth 22 ft.
Typical Section of Ditches
20-ft. roadway
Slope 1on1½
Borrow pit
10' Berm
Section of Roadway Dike
10-ft. top
Extra excavation as directed
Ditch channel
1on1½
Levee
Section of Channel and Levee Through Slough

FIG. 2—CROSS-SECTIONS OF DITCHES AND LEVEES

To prevent this, seven flood gates were constructed near the outlet and will be closed in the spring until the flood level subsides. During this period the drainage water will be held just north of the big slough in the area shut off by the dike. These flood conditions will last about six weeks normally. The gates are of cast iron, sliding vertically in grooves and fitted to a row of concrete box culverts 5x6 ft., giving a total waterway area of 210 sq.ft. The culverts are 34 ft. long, carrying a 4-ft. fill with a 20-ft. roadway. Piles 16 ft. long and spaced 4 ft. c. to c. were driven under the side walls and partitions.

Two gates of the radial type are required also on the upper part of the ditch, owing to topographical conditions. One is about halfway between the beginning or head of lateral *A* and its outlet at the main ditch; the other is in the main ditch just above the outlet of lateral *A*. The first gate was put in to keep water from backing up into lateral *A* from the well-sloped country along the main ditch and lateral *B*. The second gate was put in to hold water on the upstream side and thus prevent too rapid a flow in the main ditch. Above this gate both the main ditch and lateral *B* have ample fall, so that if the flow was not checked it would not only choke the lower part of the main ditch but also back up into lateral *A*.

*Construction Work*—Dredging was commenced in May, 1923, the entire Crow Creek channel being excavated by two floating dipper dredges with 1¼-yd. dippers. At the lower end these dredges placed all material on one side to form the dike, which was afterwards raised to grade by a dragline machine working along the dike and taking the additional material from the slough. In the big cut a 1-yd. dragline machine was used from May 1 to the completion of the cut in November. Some of the material here had to be handled two or three times, but it was considered that the work would not warrant installing a larger machine.

Another dragline excavated laterals *A* and *B*, while for the upper end of the main ditch half the length was done with a floating dipper dredge and the remainder with a land dragline machine. Seven excavators in all were employed and the work, which involved 1,064,280 cu.yd. of excavation, was completed and accepted in twelve months. Road crossings required 26 timber bridges of 15- to 38-ft. span on trestle bents. These structures, which were of the standard designs of the South Dakota Highway Commission, were built in one season by a crew consisting of a foreman with four carpenters.

The Northern Minnesota Drainage Co., Litchfield, Minn., had the contract for all ditch, concrete and bridge work. This company was the lowest of twelve bidders and its prices were surprisingly low, excavation, 11¼c. per cubic yard; lumber in place for bridges, $40 per 1,000 ft. b.m.; piling, 75c. per lineal foot; concrete, $25 per cu.yd.; clearing, $75 per acre. The total bid of $130,504 was $40,000 lower than the next lowest bid and $50,000 below the engineer's estimate. The flood gates were supplied by the Hardesty Manufacturing Co., Denver, Colo. The writer was engineer for the drainage district.

## Bituminous Road Material in Canada

AN EXTENSIVE deposit of bituminous sand occurs in the district centering about McMurray in northern Alberta, according to *Natural Resources*, a bulletin of the Department of the Interior, Canada. Numerous outcrops of this material occur along the Athabaska River and certain of its tributaries. The area represented by these outcrops, and presumably underlaid by bituminous sand, extends for 35 to 40 miles east and west, and 100 miles north and south, between west longitude 111 deg. and 112 deg. 15 min. and north latitude 56 deg. 15 min. and 58 deg. Upwards of 250 exposures, all within 60 miles of McMurray, and representing part of one continuous deposit have been examined and measured. Certain of these outcrops represent portions of a deposit that, under reasonably favorable market and transportation conditions, may, according to the Department of Mines, eventually prove commercially valuable; but only a limited portion of the area can be considered to be of present economic value if such controlling factors as thickness and character of the overburden, transportation, percentage of associated bitumen, and uniformity of material are considered. Associated with the bituminous sand are occasional small seepages of bitumen, locally known as tar springs, which originate in the richer beds but are not considered to be of economic importance. The McMurray deposits represent the largest known occurrence of solid asphaltic material. They are as yet undeveloped. However, in 1915 test sections of standard sheet asphalt, bitulithic and bituminous concrete, using material from the McMurray deposits, were laid in Edmonton, Alberta, which have shown excellent results.

Lack of adequate transportation facilities makes such experiments costly. The McMurray deposits are on the edge of civilization at the end of a railroad line which only touches the Athabaska River at one point.

# Relations of Track Stresses to Locomotive Design

## Wheel Spacing, Tire Flanges, Counterbalance Important—Effect of New Locomotive Designs on Maintenance Costs

*Abstract of a paper read before the Mechanical Section of the American Railway Association by C. T. Ripley, chief mechanical engineer of the Atchison, Topeka & Santa Fé Ry., reviewing some of the lessons for the mechanical engineer in the study of stresses in track.*

*EFFECTS of Locomotives on Curves*—In discussing the question of locomotives on curves and resulting stresses in track, the third report of the Committee on Stresses in Railway Track shows that different types of locomotives, and different designs of the same type, exert very different stresses on the rails. The pivoting action differs also, since the pivoting point may be directly under the wheels in one case and between wheels in another case, while the maximum stresses occur at the pivot point on the inside rail. It is pointed out that the surface friction between tire and rail may produce this high stress and that it is not necessary for the wheel flange to be in contact with the rail head. In fact it is not uncommon for this surface friction to induce an inward bending moment on the rail.

By the same analysis, it is evident that the rail stresses are affected by the lateral motion between box and wheel hub, and also by the wheel spacings in relation to each other. If, for example, in rounding a curve the first pair of drivers exerts an excessive stress in the high rail and the second pair a low stress, then by increasing the lateral play of the first pair of drivers, either between the hub and box or by decreasing the tire spacing on the wheel centers, there will be a tendency to equalize the stresses, permitting the first pair of drivers to take less and the second pair more of the turning load.

As the rigidity of the frame has a tendency to cause high stresses to be exerted by the front drivers in rounding curves, or actually tends to straighten out curves, there are, of course, similarly high stresses set up in locomotive frames. The trailer may also exert high stresses, partly due to rigidity and partly to the long space between the last driver and the trailer. The double trailer truck, the Delta trailer truck, flange oilers and the Franklin lateral-motion device on the front pair of drivers are all measures that have been employed to reduce the stresses exerted on the rail.

*Flanged Driving Wheels*—Tests of stresses in track on the Santa Fé Ry. indicated the desirability of fuller study of the design of the heavy 2:10:2 locomotives, as on sharp curves the stresses were very high under the fourth driver on the outside edge of the low rail and under the first driver on the outside edge of the high rail. The stresses were high also under the trailer wheel on tangent track. Tests with various combinations of flanged and flangeless tires proved that the best arrangement was with all tires flanged, making the third and fourth drivers divide the excessive strains on the low rail. The equalizing system was changed also so as to concentrate the load on the main drivers and reduce the stresses under the front and rear drivers.

*Counterbalancing*—In considering the track stresses produced by locomotives, we cannot overlook the stress produced by overbalance due to partial balance of reciprocating parts and to the fact that the forces are acting in different planes. By centrifugal force formulas we can calculate the theoretical vertical blow or dynamic augment due to the overbalance in each driving wheel. The stress records check these calculations fairly well for all wheels except the main drivers; but here an underbalance is always recorded instead of the supposed overbalance; that is, the blow on the rail occurs when the counterbalance is up. This condition calls for careful consideration by locomotive designers. In the 1917 report of the counterbalance committee of the Master Mechanics Association. it was recommended that no allowance should be made for the difference in plane of the counterbalance and the revolving parts, as the resulting discrepancies were small. This was probably true for small locomotives, but in modern heavy engines the weight of the parts as well as the difference in plane has increased so much that such allowance should be made.

The lack of allowance for difference of plane results in the counterbalance for the main wheels being too small even to balance the revolving parts, let alone the reciprocating parts. This is very undesirable from every viewpoint. It undoubtedly results in heavier maintenance charges due to harder service on tires, boxes, rods, pins and brasses, and it is the probable explanation of some of the irregular tire wear conditions on large locomotives. Enough counterbalance weight should be added at least to fully balance the revolving parts and this would produce a stress diagram which would show a straight line for the main driver.

Unfortunately, in large freight engines with their small drivers there is not always sufficient room in the main wheel centers to add this needed counterbalance. Inside bobs are one form of solution, but they are undesirable features and very large weights are necessary due to relative ineffectiveness of weight at this location. Cross counterbalancing would undoubtedly be helpful. Putting the extra weight in the other drivers is not desirable, as it increases the blow under these wheels and also increases the punishment of the middle connection brass. In many types of locomotives, the extra weight can be added to the main driver and this should be done.

The next set of experiments will be made with a heavy locomotive which is now being constructed with a different counterbalance arrangement to overcome the undesirable conditions indicated in previous tests. The main wheels are to be counterbalanced, including cross balance, making allowance for differences in plane. There will also be additional counterbalance added to the other driving wheels, in order to secure a better balance of reciprocating parts. This extra counterbalance will be added to the mate wheel in each case, rather than to the individual wheel being balanced, in order to avoid undue increase in dynamic augment.

*Electric Locomotives*—Designers of electric locomotives generally claim that these machines are easier on track than steam locomotives, owing to the absence of reciprocating parts and the lower wheel loads. Tests indicate that electric locomotives do produce lower rail stress on tangent track at high speeds. On 10-deg. curves, however, readings as high as 50,000 lb. per square inch have been developed in the edge of the base of 90-lb. rail. This indicates that designers of electric locomotives should make careful study of the pivoting action on sharp curves, as it will probably be found that these maximum stresses can be reduced, just as they have been on the 2:10:2 steam locomotives.

*New Locomotives*—A number of new locomotive designs are being developed to increase the power of the locomotive without increase in weight on drivers, which is desirable from a track stress viewpoint. Examples of these developments are the three-cylinder locomotive, the 50 per cent cutoff locomotive, and the booster equipped locomotive.

*Heavy Cars*—Practically no stremmatograph studies have been made to determine stresses under heavy loaded cars, but indications are that stresses are high enough to warrant the careful consideration of car design, particularly as regards the use of four-wheel and six-wheel trucks.

*Bent Rails*—Most motive power officials have had experience with kinked rails developed by certain locomotives. These could usually be traced to stuck wedges, or to the operation of poorly counterbalanced locomotives at excessive speeds. As the stresses produced in the rail by modern locomotives in the best condition are high, it is important that any maintenance features which tend to increase the stress should be closely watched and every effort made to eliminate them.

*Reduced Stresses in Locomotives*—The desirability of low rail stresses as an aid to track maintenance and safety is generally conceded and it has been pointed out how apparently small details in locomotive construction affect the track stresses that are produced. On the other hand, any reduction in rail stress will result in corresponding reduction in stresses in certain locomotive parts, so that the locomotive designer by giving consideration to this question will reduce not only track maintenance costs but also locomotive maintenance costs.

*Notes from Foreign Fields*

## How the Engineering Institutions Entertain in England

By E. J. Mehren
Vice-President, McGraw-Hill Co., Inc.

"THEY DO things differently in England." Of course, they do. The customs of one land must be expected to differ from those of another. Yet, I could not help using the trite expression above quoted when I attended last Tuesday evening the reception given jointly by the Institutions of Civil, Mechanical and Electrical Engineers to the overseas engineers who attended the World Power Conference.

The point of difference between their affair and ours was the combination of the cultural with the social. When our societies and their presidents receive, the diversion, beside the visiting and conversation, is dancing—which can hardly be called cultural.

Last Tuesday's function was a brilliant affair, splendid in its setting, lavish in the variety and quality of the entertainment. Only those who have seen the house of the Institution of Civil Engineers in Great George Street, Westminster, can appreciate the atmosphere that can surround a function there. An entrance hall of large proportions, the whole in finely-cut gray marble, a broad red-carpeted stairway leading up to the left; oak-paneled reading rooms, lofty and spacious, now converted to visiting and refreshment rooms, on the right. On the second floor a central hall, dome surmounted; straight ahead the Great Hall, a reception room fit for a palace and equaled with us in only our greatest hotels and a few public buildings; to the right the library (running through two stories and for the full width of the building, 158 ft.)—scene tonight of exhibits of an engineering character. Add to this permanent setting a mass of roses and of plants that only England in summer can supply, and you have a faint picture of the setting in which moved a distinguished company wearing military decorations and a considerable number of them the orders of knighthood.

In the Great Hall was the receiving line, with Sir Charles Morgan, president of the Institution of Civil Engineers, and his daughters; W. H. Patchell, president of the Institution of Mechanical Engineers, and his wife; Dr. Alexander Russell, president of the Institution of Electrical Engineers, and his wife.

From 9:15 to 10 and again from 10:30 to 11 there was delightful singing of old English ballads and folk songs by the "English Singers," a sextet under the direction of Miss Jelly d'Aranyi.

On the ground floor, throughout the evening were two demonstrations, one of a new form of cinematograph projector used in connection with slow-moving pictures, and having singular advantages for scientific study of fast-moving objects, the other of the cutting of steel under water by an oxyacetylene flame, an American development now being introduced and in practical use in Great Britain.

The library held an exhibition of engineering models and scientific apparatus, sixteen of the items being the Kelvin Centenary exhibits shown in connection with the recent celebrations promoted by the Royal Society.

Finally the string band of H. M. Royal Artillery played in the entrance hall from 8:30 to 9:15 and from 11 to 11:30, and in the Great Hall from 10 to 10:30.

Refreshments were served throughout the evening, and all tastes, Volsteadian and otherwise, accommodated.

I have gone into detail to indicate the variety of entertainment, but I would emphasize the instructional features in the demonstrations and exhibits, and the cultural in the very fine music of the English singers.

Have we not something to learn from this English practice?

The particular meeting referred to was a special one, in that it was a joint function of the three institutions, but the general plan is that used in the annual "Conversazione," as such meetings are called, of the Institution of Civil Engineers. The annual affair was held a week prior to the one here described, and in addition to these features offered a number of semi-popular lectures. At that conversazione there were 2,100 people.

Such an attendance is proof sufficient that the members appreciate this type of function no less than did the overseas engineers who were entertained a week later.

*London, July 21, 1924.*

## New Type of Canal Boat Minimizes Wave Action on Unprotected Banks

A NOVEL type of towing barge for use on canals where wave action is detrimental to the banks has been developed.

The sides of the hull on top are practically parallel forward; the bow is the widest part of the boat. The bottom is of inverted V-section and the waterline forward, instead of curving inward to a vertical stem, curves outward toward the side at any submergence and at any angle of list of the boat. The same type of hull is used for high-speed sea sled motor boats to eliminate yawing in a following sea, and for freedom from pounding

BOW VIEW OF NEW TYPE OF CANAL TOWING BARGE

of the hull, resulting from the formation of an air cushion under the forward section of the boat when running. Observation of the action of these high-speed boats led to the present development of the slow-speed canal barges. Owing to the inverted bottom, instead of a bow-wave being formed which extends away from the vessel as it runs, the bow-wave is practically swallowed by the hollow bow section. At speeds of from seven to eight knots these craft run with very little displacement disturbance.

The new canal barges are 97 ft. long and have a 70-ft. beam. The keel is above the ridge line throughout, but as the keel line lowers rapidly immediately behind the bow section the capacity of the barge is not substantially reduced. Planking is laid athwartship so that the construction is as simple as in the ordinary type.

These boats are built under license from the Sea Sled Co., of West Mystic, Conn.

# A Return to Checks and Balances and Decentralization

## New Charter for Los Angeles Creates Interdependent Mayor and Council with 19 Administrative Boards, 16 Managers, Several Chief Engineers and a City Engineer

LEADING FEATURES of the new charter for the city of Los Angeles, adopted by a large popular majority last May, effective July 1, 1925, are a mayor, a small council, an attorney, a controller, and a small board of education, all elected at large, together with nineteen administrative boards and a possible twentieth, a city clerk, city prosecutor, purchasing agent, and city treasurer, all appointed and removable by the mayor, but subject to confirmation by the council. Sixteen of the administrative commissions appoint a general manager and the seventeenth, the board of public works, appoints a city engineer. A novel feature of the charter is provision for a housing commission with power to issue bonds and receive gifts for use in providing housing facilities for people of small incomes. The charter contains initiative, referendum and recall provisions, the latter to apply to appointed as well as elected officials. Besides the housing commission, another unusual feature of the Los Angeles charter is a provision for the creation of boroughs. The boroughs could be created only in territory that had been annexed to the city or consolidated with it and would have limited powers.

*Mixed Responsibility*—Besides this decentralization, there is in the new charter a further division of responsibility in that the mayor, although called the "chief executive," and the council have no separate powers, or at most only minor ones. All appointments and removals made by the mayor (except his own secretary) are subject to confirmation by the council. There is the same mixed responsibility in all matters requiring action by ordinance, including the final adoption of the budget.

Each of the eleven members of the council is to be paid $4,800 a year. The term of office is two years. The council must meet at least five times a week. Each member of the council is to head a committee of three council members, the chairman and other members of which are appointed by the president of the council. These committees merely serve in an advisory capacity to the whole council in matters of legislation, each committee having allotted to it by ordinance a portion of the "functions" of the council. The council has no powers whatever except those of legislation, budget making, and the approval or rejection of the mayors' appointments.

The board of education consists of eleven members, some serving for four and some for two years, and all at a nominal compensation of $5 a meeting, which is limited to $50 in any one calendar month. Apparently this board is supreme in all educational matters, including the budget and bond issues, but its financial and other operations are subject to general state legislation.

The mayor is elected for a four-year term at a stated salary of $10,000 a year. His appointments and removals may be nullified by a majority vote of the council. His ordinance vetoes may be overcome by a two-thirds vote (8 of 11) except where a three-fourths vote of the council is necessary for an enactment, in which case three-fourths vote of the council (9 of 11) is required to override the mayor's veto. He frames the budget but if the council can muster 8 votes it can mold the budget to its liking.

The only salaries specified in the charter, aside from those of the members of the council and the mayor and meeting-attendance allowances for a number of boards, are $10,000 a year for the city attorney, and $7,200 for the controller. These officers are elected for two-year terms. All appointed officers receive the salaries in force when the charter takes effect or such salaries as may be prescribed by ordinance. No one is to be paid by fees or commissions. Members of the 16 "citizen boards," like those of the board of education, are paid $5 a meeting, but not to exceed $50 in any calendar month. Some of the 16 "citizen boards" divide with the board of public works the construction or the operation of municipal works and services, and others have advisory or regulatory powers only. As arranged alphabetically in the charter these boards are: Building and safety; city planning; civil service; fire; harbor; health; humane treatment of animals; library; municipal art; park; pension; playgrounds and recreation; police; public utilities and transportation; social service; water and power. Five of these boards make their own budget quite independent of the mayor-council general budget: Harbor; library; park; playground and recreation; water and power. The municipal housing commission may issue bonds "under certain terms and conditions which shall be prescribed by the council by ordinance for any of the purposes for which the commission is created." Twelve of the fifteen members of this particular commission are selected by the mayor, subject, like the members of the other commission to confirmation by the council, from the four largest holders of the bonds of the housing commission.

Each of the "citizen boards" appoints a secretary, a chief accounting officer and a manager. The latter is subject to removal by the board and is under its direction. In general, the administrative boards have five members each. The powers and duties of some of these boards will be mentioned further on.

*Public Works*—The board of public works is put in a different class from the "citizen boards," but its members are subject to appointment and removal in the same manner. The five members of this board, which constitute the department of public works, have to devote all their time to their duties. Their pay is to be fixed by ordinance. The board has charge of all special assessment work and all proceedings relating to advertising for bids for any work or improvement ordered by the council or by the board itself. More particularly, the board is responsible for the construction and maintenance of streets and sewers; street cleaning, sprinkling and lighting; park lighting; public buildings; and the disposal of garbage, sewage and street cleanings.

The board of public works appoints a city engineer, a deputy city engineer, an inspector of public works, and various other inspectors and employees, and, subject to civil service rules, may remove its appointees.

The city engineer is required by the charter to do civil engineering and surveying for the board of public works and such other work as the council may direct or as may be required by the city charter, ordinances, general laws of the state, or the order of the board of public works, and he is also designated as the custodian of city maps and plans.

"Citizen boards" in charge of more or less important construction work include building and safety, which constructs, maintains and operates police and fire alarm systems, and also enforces all building and similar laws; harbor, which has large powers of construction, maintenance and operation of harbor and waterfront work, together with the collection of rents and the granting and control of utility franchises pertaining to the harbor only; park, and also playground and recreation, each with construction and maintenance work indicated by their titles; water and power, which has charge of the construction, maintenance and operation of the city water-works, and also the municipally-owned electric light and power plants. In a class by itself, with powers of construction and maintenance, is the municipal housing commission. The particular duty of this commission is to provide homes for those who might otherwise live in "overcrowded tenements, unhealthy slums, or the most congested areas" of the city. The bonds issued by this commission can be secured only by the property which it may own. Of the 15 members of this commission, all appointed by the mayor, 12 are chosen from the 24 largest holders of bonds issued by the housing commission.

Two "citizen boards" whose work is of particular interest to engineers, but which have no powers of construction or operation of public works, are the city planning commission and the public utilities and transportation commission. The function of the latter is to regulate private utilities. The city planning commission has advisory powers only. The plotting or subdivision of lands, zoning, the location of public buildings, public parks, or playgrounds, and "subjects related to the opening and widening of streets and other physical conditions connected with the development and expansion of the city," come under the jurisdiction of the commission, but its powers do not go beyond making reports and recommendations. Certain of these matters must go to the city planning commission before being acted upon by the city council or by various administrative departments, but the recommendations made by the city planning commission are not binding upon the council or departments.

*The Civil Service Commission*—This is one of the "citizen boards," is directed by the charter to classify "all officers in places of employment" except for certain exemptions "with reference to the examinations herein provided for." Exemptions include all officers elected by the people, all members of the several boards, the city engineer and his chief deputy, the general manager of 12 of the 16 departments in the charge of "citizen boards," (civil service, fire, police, and social service managers not being exempt) the chief engineer of waterworks, the harbor and assistant harbor engineer, inspector of public works, and a considerable number of other officials, including apparently all employees of the board of education, the city attorney, the city prosecutor, the principal members of the staff of the public library, and others. A considerable number of other exemptions may be made by order of the commission.

A salary standardization commission is provided for, made up of a representative from the council and from each authority authorized to fix salary or wages. Included on this committee is the director of the bureau of budget and efficiency, an official for whose appointment the charter seems to make no provision and whose powers and duties do not seem to be defined except by inference from mandatory provision to the effect that copies of departmental budget estimates and of the mayor's budget shall be filed with this official.

*Budgets*—There are at least six, and apparently seven (including the board of education) budget-making bodies, entirely independent. "The general budget" is in the joint control of the mayor and city council. Five of the citizen boards, some of which have large receipts and expenditures, have absolute control of their budgets. These include the harbor, library, parks, playground and recreation, and water and power commission, which are merely required to file copies of their budgets "for the information of the council and the public." Some measures of control of the financial operations of these bodies, however, may come through the ordinance powers of the council and mayor.

The mayor frames the budget from department estimates; that is, power is lodged in the mayor but presumably the work is done in large part by the bureau of budget and efficiency, the director of which may be called upon by the mayor for "clerical, technical and advisory assistance." The council may by a majority vote increase, decrease or omit any item and insert new items in the budget submitted to it by the mayor. Subsequently the mayor may veto the budget, "in whole or in part" or may reduce any item that it contains. If this is done, the budget then goes back to the council, which may "overcome" the veto by two-thirds vote of all its members (8 out of 11). The charter guards against possible failure of the council to adopt a budget by providing that in such a case the mayor's budget, after possible adjustments noted as necessary by the controller to keep within the tax limit, shall become effective.

*Creation of Boroughs*—Boroughs of limited local powers maye be created in territory annexed to or consolidated with the city, but they must comprise an area of at least 4,000 acres and have a population of not less than 40,000 or more, both subject to determination by the city council. The petition initiating a movement for a borough must be signed by 25 per cent of the voters in the proposed borough area. After an advertised hearing, the council, in its discretion, may provide for an election upon the formation of a borough comprising either the area named in the petition or an area determined by the council. If the majority of the votes cast at the election are in favor of the borough, then the mayor appoints an advisory borough board of five members, to serve for five-year terms. At the end of two years 25 per cent of the voters of the borough are sufficient to initiate an election on changing from appointive to elected members of the borough board.

The advisory borough board appoints an inspector and manager, adopts a borough budget and levies a borough tax not to exceed 10c. per $100 of the assessed valuation of property within the borough. This tax is collected with the city tax but is not charged against

the city tax limit. Any borough board may request the city council to call a special borough election to vote on special district taxes or bond issues, the proceeds to be spent by the appropriate city department "in providing or supplementing any municipal function within the borough or any borough function as set forth" in the call for the election.

*Taxes*—The general tax rate of the city is limited by the charter to $1.25 per $100, for all municipal purposes, except provision for bonds and interest, district bonds, borough taxes or special district taxes. Six cents on each $100 of taxable property is set aside from the proceeds of the tax levy as a "permanent improvement fund" to be used for no other purpose than for providing lands, rights-of-way, or buildings or other public works or improvements of an estimated life of not less than ten years.

The tax limit of the city is fixed at 3 per cent, except that 12 per cent additional may be incurred to acquire, construct or complete any municipally-owned utility, "including, among others, water, power, and harbor utilities." If the city council by ordinance declares any utility to be self-maintaining, then the bonds issued for that utility may be excluded from the debt limit, but this must be done by ordinance and be approved by a majority of the voters voting thereon at an election. The indebtedness of any borough or other special district or of the Los Angeles city school district is not to be included in computing the debt limit.

The utility franchise provisions of the ordinance go into considerable detail as regards protection of the interests of the city. Provision is made for franchises of indeterminate length. New franchises must provide for the purchase by the city of the property of the utility company, and nothing shall be paid for "franchise value, good will, going concern, earning power, increase in cost of reproduction, severance damage, or increased value of right-of-way."

A paragraph of the charter designed to protect the city against exactions on account of patented payments provides that: "No pavement protected by any patent, trademark, trade name, copyrighted name, or any device that tends to prevent competitive bidding, shall be ordered by the city, until the owner thereof has entered into a written agreement with the city transferring to the city all right to the use of the same within the city upon the terms and conditions set forth therein. The city shall not be bound by any such agreement unless the same shall have been approved by a majority vote of the board of public works, two-thirds vote of the council, and the mayor, and executed by the mayor on behalf of the city. No such agreement shall be for a longer period than five years." The city shall be reimbursed by the contractor for the amount of any royalty which the city agrees to pay for the use of patented pavements.

Building heights are restricted to 150 ft. within a specified district and are further limited outside of that district, "except in districts zoned for manufacturing and industrial purposes and authorized by ordinance." No building shall be more than 13 stories high.

Publication of any newspaper at the expense of the city is prohibited by the charter. (The city ran a daily newspaper some years ago.)

Traffic studies must be provided for by the city council by ordinance within 90 days after the charter becomes effective and rules and regulations to goven traffic may be recommended to the council. Such recommendations must be voted upon by the council within thirty days of their receipt. The duty of making these traffic studies may be placed by the council upon the boards established by the charter "or upon a board created by ordinance," the members of such a board to be appointable and removable by the mayor, subject to confirmation by the council and generally to be under the regulations applying to "citizen boards."

All purchases of materials and supplies, with the exception of those for the harbor, library and the water and power departments, are made by the city purchasing agent, with or without more or less specification control "by the department, officer or employee for whom the purchase is being made," except that certain minor emergency purchases, not exceeding $25, and totaling not more than $100 during any one month, may be made directly by the board, officer or employee concerned, and that under some conditions blanket purchasing orders up to $500 a month may be made to the order of a department, officer or employee. Where the purchases under the control of the purchasing agent amount to $1,000 or less, the purchasing agent makes the purchases "upon requisition delivered to him and signed by the department, officer or employee for whom the purchase is to be made." If the amount of the expenditure is to exceed $1,000, then "the specification on which bids were asked must first have been approved by the purchasing agent and also by the department, officer or employee for whom the purchase is being made, or in lieu of the latter, by the director of the bureau of budget and efficiency, and provided further, that the acceptance of any bids in such case shall be approved" as stated just above. In the case of purchases exceeding $2,000, for the department of public works, that "department shall have entire authority to prepare the necessary specifications without the approval of the purchasing agent and no contract with such person shall be awarded or made by the purchasing agent without the approval of the board of public works."

*Appointments*—Qualifications for certain officers appointed by the mayor, subject to confirmation by the council, are specified in the charter; and the mayor in submitting appointments to the council for approval must certify that in his opinion the person named is "especially qualified by reason of training and experience for the work which shall devolve upon him, that I make the appointment solely in the interest of the city." The special qualifications laid down in the charter for certain officials are:

The city attorney "must be qualified to practice in all the courts of this state, and he must have been so qualified for at least five years preceding his election."

The city engineer, who is appointed by the board of public works to hold office at its pleasure, "shall be a civil engineer of not less than five years' professional experience." Both the city engineer and city attorney must devote all their time to the work of their offices.

The health officer "shall be a graduate of a reputable college of medicine and shall have had at least three years' experience in the administration of public health work."

The general manager of the department of water and power, *provided* the board in charge does not exercise

its option to divide this department into a bureau of water-works and supply and a bureau of power, "shall be the chief engineer of the department and shall have recognized ability and broad experience in hydraulic and electrical engineering and the economics of water and electrical utilities." Should such a division be made, then the general manager of the bureau of water-works and supply is to be known as the chief engineer of that bureau, and the general manager of the bureau of power and light will be known as the chief electrical engineer, and no qualifications for these two officers or for the general manager are specified in the charter. Removal of the department general manager or the bureau general managers in the department of water and power requires a two-thirds vote of the board of five members and a like vote is required for removal of the city engineer by the board of public works.

The Los Angeles charter was framed by a board of fourteen freeholders, elected at the general municipal election June 5, 1923. One of the members was Franklin D. Howell, who in 1923 was president of Los Angeles Section of the American Society of Civil Engineers. The charter draft was officially completed Dec. 10, 1923. It was adopted by vote of about 144,000 to 40,000 on May 6, 1924, subject to ratification by the State Legislature that convenes this fall. The ratification is taken for granted, in accordance with long custom as regards home-rule charters in California. The charter becomes fully effective July 1, 1925, when the new officials elected under its provisions take office.

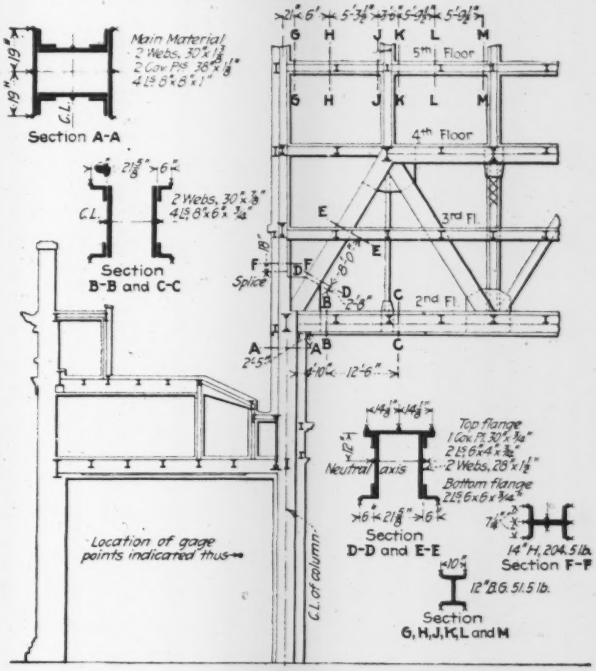
## Will Measure Stresses in Steel Frame of Philadelphia Building

ARRANGEMENTS have been made by Stone & Webster, engineers and builders of the new office building of the Insurance Company of North America, in Philadelphia, in conjunction with the architects of the building, Stewardson & Page, of Philadelphia, to conduct extensometer measurements of stresses developed in certain main elements of the steel frame of the building during erection. L. J. Towne, structural engineer of Stone & Webster, is directing the work, which is to be carried out with the co-operation of Prof. F. O. Dufour, of Lafayette College, Easton, Pa.

A vertical section through part of the building, shown in the sketch herewith, indicates the location of the principal gage points. The main part of the first story of the building is occupied by a high banking room; this is spanned by trusses two stories deep, which carry four columns extending the full height of the building. The large forces which are caried by the heavy members of this truss and the rigid gusset-plate connections give an excellent opportunity for determining stress distribution and secondary stress effects in a typical but unusually massive arrangement of steel building framework. The gage points indicated on the fifth floor beams at the same time will give information concerning bending stresses in ordinary steel floor framing and the restraint effected by the columns.

All measurements are to be made on 8-in. gage lengths, laid out along the center lines and the corners of the several members included in the measurements (see detail sections in the sketch). It is probable that lever extensometers of the Berry type will be used for making the measurements. Comparison measurements on a standard bar will reduce temperature corrections to a minor importance. The actual load on the members at the time each measurement is made will be determined from the construction records.

Steel erection on this building has just been begun.




VERTICAL SECTION OF BUILDING SHOWING LOCATION OF GAGE POINTS FOR STRESS MEASUREMENTS

The stress measurements are expected to extend over the coming autumn season, so that results may be available by winter.

## Asphaltic Concrete Laid on Shiplap Subgrade

In the city of Portland, Ore., in 1910 a contract was let to pave Division St. with a 2-in. asphaltic concrete wearing surface. Although work progressed rapidly, winter rains set in before the contract was completed, rendering it practically impossible to prepare the subgrade. A portion of this street, between 39th St. and 40th St., was still incomplete when the wet condition of the base forced the work to a close. Division St. is an important outlet from the city and it was quite essential that the street should be opened to traffic. Adjacent property owners and others who use this street petitioned that the contractor be allowed to proceed. It was decided that the contractor should place 1-in. shiplap from curb to curb over the mud in the street. Upon this lumber, the 4-in. compacted crushed rock base was laid, and over this was placed 2 in. of asphaltic concrete wearing surface. The work was finished in December, 1910. Today Division St. is one of the main thoroughfares from the center of the city of Portland to sections of the city and outlying districts, as well as to the state highway leading south. Although traffic is heavy, this pavement is in good condition and likely to withstand many more years of service. Where the subgrade has settled slightly, the asphaltic concrete has conformed to the settlement and has not broken but has sealed the base so that no surface water can reach it to soften and destroy its supporting quality.

# First International Sanitary Engineering Conference

## American Engineers Contribute 14 of 41 Papers Scheduled and 6 of 10 Papers on Activated Sludge—Sewerage, Water, Refuse, Plumbing and Health Administration Practice Reviewed

SPECIAL REPORT FOR *Engineering News-Record*

BY HARRISON P. EDDY
Of Metcalf & Eddy, Consulting Engineers, Boston, Mass.

FORTY-ONE papers by engineers, sanitarians and public health administrators from eight countries were presented at the first International Conference on Sanitary Engineering held at London, July 7 to 10, 1924, under the auspices of the Institution of Sanitary Engineers. Sewerage and sewage treatment filled nearly half of the program, the activated-sludge process alone having ten numbers. Water supply and purification and garbage and refuse disposal had four papers each. There were four papers on administration of health and sanitation, including malaria and yellow fever control, and four on plumbing. Fourteen Americans were on the program, and still others were in attendance. The papers and discussions will be published in a single volume which can be obtained by communicating with P. N. Hasluk, Secretary, 120 Victoria St., Westminster, London, S. W. 1.

The conference was opened by J. S. Alford, president of the Institution of Sanitary Engineers. In the course of his address he suggested that the words "sanitary engineer," as designating one practicing in this field are unfortunate, and proposed "sanitation engineer" instead.

*Administration of Health and Sanitary Services*—The first paper on the program, "Sanitary Administration in England and Wales," by I. G. Gibbon, assistant secretary, Ministry of Health, gave an admirably clear statement of the classification, respective powers and organization of the local authorities in England and Wales, having jurisdiction over sanitary matters. The amount expended on "sanitary services" in these two countries during the year ended March 31, 1922, was said to have been $313,340,000, or nearly 15 per cent of the total expenditure for all purposes. It is estimated that 85 per cent of the population of England and Wales have public water supplies available to them.

H. Percy Boulnois, for many years city engineer of Liverpool, gave from personal experience an account of "Fifty Years of Sanitation in England," pointing out the great advances made and suggesting that "probably a writer in the year 1974 will have much to say as to our want of knowledge in 1924 and of our mistakes."

B. Bezault, Paris, called attention to the marked progress in sanitation since the armistice, especially in the devastated areas where reconstruction has made sanitary measures imperative. These have been aided to some extent by government contributions, "the law relating to betting at race meetings and games in clubs," Mr. Bezault said, "provides for the payment of relatively considerable sums which must be used for works of sanitation."

Sanitary problems and progress in the Malay Peninsula were described by Sir Malcolm Watson, of Klang, Federated Malay States. Nearly 40,000 lives, he estimated, have been saved by sanitary measures in Singapore alone in the last eleven years. The author referred to the valuable work of Sir Ronald Ross in discovering the mode of transmission of malaria, after which the latter favored the conference with a brief and well received address.

The United States contributed three papers in this group. A paper sent by J. A. Le Prince, senior sanitary engineer, U. S. Public Health Service, recounted the educational campaign required, and now happily well advanced, to bring the public to a recognition of the practicability and economic advantages of malaria control. In "Yellow Fever Prevention Work Along the Mexican Border," R. E. Tarbett, sanitary engineer, U. S. Public Health Service, described the health zone established to prevent and protect the state of Texas and the southern section of the United States against entrance of the disease. W. L. Stevenson, chief engineer, Pennsylvania Department of Health, described the organization and functions of the Engineering Bureau of his department, thereby affording valuable opportunity for comparison of central authority activities in the United States and in England.

*Activated Sludge*—Of ten papers on the program dealing with the activated-sludge process of sewage treatment that upon "Flocculation in the Scheme of Sewage Purification," by John D. Watson, consulting engineer to the Birmingham, Tame and Rea District Drainage Board, alone was missing, because of the absence of the author in India. The new unit at Withington (Manchester, England) was described by Edward Ardern, consulting chemist, Manchester Rivers Department. This unit had been in regular operation about nine months, treating an average of nearly 1.5 m. Imp.g.d. of rather dilute (for England) domestic sewage, or about 50 gal. per capita daily. The paper contained unusually complete operating data, including analyses of sewage and effluent. The average power consumption has been 19 b.hp., which will probably be slightly reduced in the future to 18 b.hp. The cost for power alone has been $4.09 per 1 m. Imp.g.d. at about 1.4c. per kw.-hr. The quality of the effluent has fully met the Royal Commission standard.

Joshua Bolton, manager of the sewage-works of Bolton, England, described the 50,000-gal. activated-sludge unit there which combines in a single tank agitation of the sewage mixed with activated sludge, and settling of the sludge out of the aerated sewage—one of the simplest of the installations for this method of treatment. Mr. Bolton found that the process has considerable elasticity with respect to interruption, the tank in one case having been shut down for four days, yet upon renewal of operation good results following after the tank contents had been circulated for 3 hr. This indicates the possibility of power conservation through intermittent operation. Repeated (5 days) use of activated sludge as a coagulant gave results of much interest.

The applicability of the activated-sludge process to tropical conditions was discussed in a paper by Prof.

Gilbert J. Fowler, now of Bangalore, India, who briefly described the plants at Jamshedpur (near Calcutta), designed for 3,000 persons; Indian Institute of Science, Bangalore, serving 450 persons; and Shanghai, serving a portion of the central third of the city. Dr. Fowler believes that this process has proven its applicability to both small and large communities in the tropics and is hopeful that "it will play its part in the increasingly difficult and important problem of food supply for the large and increasing populations of the East." Both sludge and effluent from these plants have been utilized for irrigation with favorable results.

A half-dozen American authors dealt with activated-sludge plants in this country. Four of these papers had to do with the plant and accompanying researches at Milwaukee, Wis. T. Chalkley Hatton, chief engineer, Milwaukee Sewerage Commission, described the plant which he is constructing there and in a second paper he laid particular stress upon sludge dewatering and marketing.

In the third Milwaukee paper John Arthur Wilson, consulting chemist, Milwaukee Sewerage Commission, gave an account of the researches upon the dewatering of the Milwaukee sludge and pointed out some of the valuable lessons learned from an application of colloid chemistry to this problem. In the fourth Milwaukee paper, "Investigations of the Fertilizing Value of Activated Sludge," Victor H. Kadish, assistant to the chief engineer, Milwaukee Sewerage Commission, gave a typical analysis of activated sludge at Milwaukee, containing as much as 7.42 per cent of ammonia with a total availability of 71.48 per cent. Observations were reported of results of sludge treated with acid as compared with aluminum sulphate and the work of the College of Agriculture of the University of Wisconsin, which has established a fellowship in connection with the fertilizing value of activated sludge, was described.

The essential design and operation data for the two activated-sludge plants at Houston, Tex., were given by J. C. McVea, city engineer. The data for 1922 and 1923 furnish opportunity for comparison of English and American experience. Houston appears to be fortunate in securing the power at 0.6c. as compared with Withington at 1.4c. per kw.-hr. The spiral circulation induced by diffused air at the Indianapolis activated-sludge plant was described in a paper by Charles H. Hurd, chief engineer of the Sanitary District of Indianapolis, who also presented data on the design and estimates of power consumption.

A paper by Langdon Pearse, sanitary engineer, Sanitary District of Chicago, summarized experience in the United States in dewatering, drying and preparing activated sludge for the market. Notwithstanding the large amount of investigational work done it is evident from the statement of facts that the progress in this field has been fraught with many difficulties, that the different sludges do not lend themselves to treatment with equal readiness, and that a treatment which gives encouraging results in one city may not be the best in another. Much research work remains to be done.

*Sewage Treatment in General*—J. H. Garner, chief chemist, West Riding of Yorkshire Rivers Board, gave an interesting historical survey of progress in sewage treatment from about 1850 to the present time. In France, stated B. Bezault, Paris, in a paper mentioned elsewhere in this article, the septic tank followed by trickling filters is common; a few activated-sludge plants have been installed.

A resumé of sewage treatment in Scandinavia and Finland was given by George Peel Harvey. On account of climate the fixed nozzle with intermittent discharge under varying head has been found more practical than traveling distributors unless the filters equipped with them are housed. Interesting results were cited of treatment of yeast factory wastes, some of which contained 10,000 to 11,000 p.p.m. total solids, of which about 90 per cent were organic, with an oxygen-consumed demand of 4,000 to 5,000 p.p.m. Several forms of biological life on trickling filters were described.

The town engineer of Jamshedpur, India, F. C. Temple, outlined some fundamental considerations in the design of grit catchers, screens and storm-water tanks. Among other things was mentioned the advisability of maintaining storm-water tanks full of relatively clean water, so that they may function normally as soon as the storm discharge begins, also affording some dilution for the first, very foul, portion of the storm discharge.

The status of sewage treatment in the Province of Ontario was described by F. A. Dallyn, director, Sanitary Engineering Division, Provincial Board of Health, Toronto. Sewage treatment other than sedimentation is not required by the government, except where the stream is unable to receive untreated sewage, or where a definite hazard to health exists on account of bathing beaches or water sports. He gave the "annual anticipated cost" of operating activated-sludge plants as follows: Woodstock, $14.30; Brampton, $13.70; Timmins, $18.48; Guelph, $16.60.

*Friction in Sludge Pipes*—William Clifford, manager and chemist, Wolverhampton sewage-works, England, gave results of tests of friction for "average" sludge made with a 4-in. force main, the lengths varying from 591 to 3,801 ft., the average friction head for average sludge being 24.5 ft. per 1,000 ft. of pipe. His tests demonstrated that friction with watery sludge differs little from that with water, but that it rises rapidly as the proportion of solids increases beyond 10 per cent. As "first approximations," friction values were given for 4-, 6-, 9- and 12-in. pipe at velocities of 2.5, 3.5 and 5.0 ft. per second.

*Sewerage Practice*—Edward Willis, engineer and surveyor, Chiswick, England, gave an interesting resumé of past and present English practice in the jointing of sewer pipe. While undoubtedly much greater care is taken in making good watertight joints in England than in America, the general methods used appear to be similar in both countries. The tarred-gasket-and-cement joint is in common use but the bitumen joint has advantages in wet ground, this being often faced with cement mortar.

Difficulties encountered in the sewerage of low areas in Holland where the soil is either sand or peat and the surface of large areas is below the level of the sea, rivers and canals, were described by B. A. Verhey, president of the Dutch Society of Consulting Engineers. The installation of sewers below ground-water level, aside from being subject to difficulties in construction, causes settlement of the peaty soil and lowering of ground water, thus endangering the life of wooden piles. This condition is avoided in some cases by filling the low ground with sand; in others by the adoption of

booster pumps, for which service the automatic electrically-driven centrifugal pumps are particularly well adapted.

Walo Von Greyerz, consulting engineer, Vattenbyggnadsbyran, Stockholm, Sweden, presented a paper upon limiting by size of gutter inlets the volume of storm runoff admitted to combined sewers, thereby impounding the water until the period of intense runoff has passed. In this way the author hopes to avoid the need of very large sewers and prevent inundation of basements. Erland Hedström, chief of the Department of Streets, Stockholm, stressed the economy of utilizing sewers for carrying away snow, augmenting the flow by water from the municipal mains or by pumping from other sources where necessary. Special snow shafts and the location of snow-carrying sewers at side instead of center of streets, were also suggested.

*Treatment of Industrial Wastes*—Dr. H. Kessener, director, Dutch Government Institute for Purification of Waste Waters, presented a copiously illustrated paper on experimental work upon purification of liquid wastes from the sugar, dairy, strawboard and potato-flour industries, describing also some permanent factory installations for wastes treatment. Chemical analyses of the wastes and effluents were included. All of these wastes were found to be susceptible to purification by the usual biological methods, as in the septic tank and trickling filter, although sometimes requiring preliminary modification of acidity or alkalinity. Activated-sludge treatment gave promising results in all cases.

A resumé of industrial wastes treatment in the United States was presented by the present writer.

*Pumps for Sewage and Water*—The extent to which electric-motor-driven centrifugal pumps have been utilized recently in Sweden for water and sewage was set forth by John Bergström, chief engineer of the Stockholm water-works. The author held that centrifugal pumps are now on a par with piston pumps, in point of both economy and reliability, especially when arranged for electric drive.

*Water Supply and Treatment*—Percy Griffith (England) pointed out that the natural development of water resources is through individual initiative, as use precedes need for state intervention and control; and that with the development of the state, control becomes important first to meet sanitary requirements and later for other uses based on economics. Such control can be obtained (1) through state ownership, or (2) by the state prescribing a limit to the claims of riparian owners and establishing state control of allocation. The author claims national sources of water as a national asset, or property in which the interests of the community take precedence over those of the individual. This he claims is the basic principle. Aside from vested interests, or rights, it would be simpler to declare all natural sources of water to be state property, but under all the conditions it seems preferable to proceed by way of state control. It is necessary, therefore, that landowners' rights should be limited, Mr. Griffith suggests, to such quantity of water as may be reasonably necessary (a) for the health of the residents on his land, and (b) for the economic development of his land having regard to its natural resources and not to its commercial use for purposes independent thereof. Water for its commercial use should be subject to specific allocation by the state.

Prof. S. Rachokovitch called attention to the inability of slow sand and mechanical filtration to furnish a sterile water and the efforts made to accomplish this by adding chlorine, stating that "the use of chlorine is not a permanent method of safeguarding the population from the propagation of contagious disease in drinking water. . . ." He then gave results of experiments to determine the efficiency of ozone production under different methods of operation, and of comparative tests of treatment of Neva River water prepared by slow sand filtration and by coagulation and rapid filtration.

Dr. Jan. Smit, private lecturer in microbiology, Amsterdam, Holland, gave a resumé of drinking water supplies in the Dutch East Indies, with an interesting account of the lack of understanding of the first principles of hygiene on the part of the natives and the consequent difficulties encountered in securing freedom from intestinal diseases.

Water-works practice in Sweden was reviewed by Alfred Jerdén, chief, municipal water-works, Malmö. Although in Sweden there is comparatively little good water-bearing sand and gravel, about half the cities are supplied with ground water, including Malmö, the third city in size (115,000 population). In general, the surface water supplies are free from gross pollution and are readily purified by sand filters. There are some rapid filters, the effluents being treated with chlorine—a chemical discovered by the Swede, Scheele, as early as 1774. Deducting the water used for manufacturing, the consumption averages, in metered and unmetered cities, 80 and 120 liters per capita per day, respectively. In the twenty largest cities, where the average price of water is about 15c. per 1,200 (U. S.) gal., that used for the industries averages 25 per cent of the total consumption. In 10 per cent of the cities, water for domestic uses is free.

*Garbage and Refuse Collection and Disposal*—British refuse collection practice was reviewed by J. A. Priestley, cleansing superintendent, Sheffield, England. Garbage, rubbish and ashes unseparated, averaging 2½ to 3 cu.yd. per long ton, are collected customarily once a week. The collecting vehicles are covered after loading. For short hauls horses are used, but steam, gasoline and electric motor-driven vehicles are also employed, the latter being considered especially suitable. Records of individual collections and of the weights of the refuse collected are found valuable. In a paper on "Refuse Disposal by Separation and Salvage," James Gair, highways engineer, Metropolitan Borough of St. Marylebone, London, called attention to the interest in the subject of salvage, plants having recently been installed at Sheffield, Westminster, Newark and Birmingham. In the past year, of 40,174 long tons of mixed refuse 13,580 tons were sold, producing a revenue of about $21,760. Mr. Gair felt that progress in refuse disposal had been small compared with that in sewage disposal, and that this could only be obviated by more drastic regulations regarding dumping. He compared the financial data of sewage and refuse disposal in England and Wales for the year 1919-1920 as follows:

| | Outstanding Loans | Annual Cost* |
|---|---|---|
| Sewage Disposal | $171,630,000 | $27,964,000 |
| Refuse Disposal | 22,000,000 | 33,000,000 |

*Including loan charges; £1=$4.40.

American experience and current practice in refuse

disposal were treated by Samuel A. Greeley, hydraulic and sanitary engineer, Chicago, who pointed out that "American cities have considerably more refuse to dispose of than English or Continental cities, the average production of house refuse in America being 1,060 lb. per capita per year. After describing various methods of disposal, supported by valuable cost figures, he called attention to the need for more exact and far-reaching data on operation of disposal plants, to serve as an aid to design, and suggested the wisdom of securing such information from operation of small working-size units as has been done in the field of sewage disposal.

*Plumbing*—There were three papers from America and one from Sweden on this subject. William C. Groeninger, past-president of the American Society of Sanitary Engineering, in a paper on the "American Model Plumbing Code," emphasized the need of good plumbing and of uniformity in practice. He mentioned the advance in uniformity resulting from the passage of the Ohio State Plumbing Code. In a paper entitled "English and American House Drainage," Prof. George C. Whipple, Harvard University, Cambridge, Mass., described the work done under the auspices of the U. S. Department of Commerce toward remedying the present chaotic condition of American plumbing practice. He pointed out the wide divergence in American and English practice and the changes which have taken place in the theory of transmission of disease by sewer air, upon which present practice to a large extent is based. John S. Hodgson, Washington, D. C., summarized the divergence in English and American plumbing practice, his conclusion being that in America scientific design, high-class fittings and first-class workmanship were relied upon, despite attendant expense, whereas in England the impossibility of securing these essentials appeared to be assumed.

Prof. Klas Sondén, M.D., Stockholm University of Technology, described Swedish plumbing practice, which seems to resemble the American more closely than the English. Thorough regulation and inspection by the authorities is of comparatively recent origin, but is now much like that in the better regulated American cities.

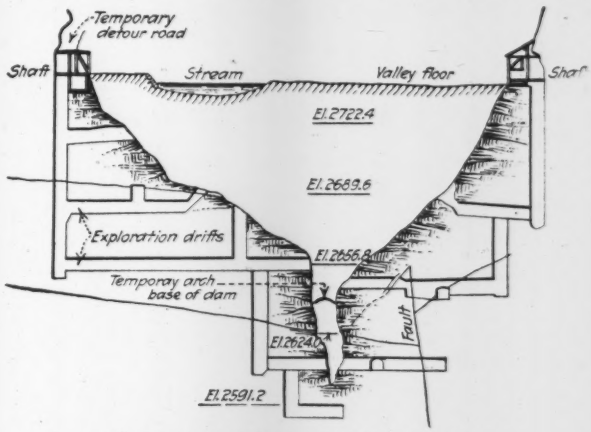
## Stress Measurements on Chicago Viaduct

Measurements of stresses in the girders of the South Park Boulevard viaduct at East 23rd St., Chicago, are shortly to be made by arrangement of L. F. White, chairman of the South Park Commissioners, and T. L. Condron, consulting engineer to the board. The viaduct is 624 ft. long and 111 ft. wide, and consists of six lines of plate girders which are continuous over three spans, each about 96 ft. between supports. The viaduct has a concrete deck. The measurements will be made on the first interior line of girders in the middle span of the three continuous spans. Gage-points are to be established on the lower chord of the girder, at points near midspan, near the inflection points under dead-load, and close to the columns, also at top and bottom of the columns at the two ends of this span and on the columns at the ends of the continuous girder, these latter columns being pin-connected at top and bottom. The initial readings will be made under the dead-load of the girders only, and subsequent readings under partial and complete dead-load and if possible under live-load.

## Swiss Engineers Build Body of Dam Before Foundation

AT THE SITE of the storage dam of the Wäggithal power plant, in Switzerland, the rock valley was found to lie at considerable depth below the alluvial valley bottom. This led not only to unusual methods of exploring the site to determine the conditions which had to be met, but also to an unusual construction expedient, namely building the lower seal of the foundation after the main body of the dam.

As indicated by the cross-section herewith, reproduced from *Schweizerische Bauzeitung* of July 5, 1924, p. 8, the main rock gorge is some 80 ft. deep below the stream, and a narrow cleft or inner gorge descends 50 or 55 ft. farther. To obtain precise information on the rock profile shafts were sunk in the second rock on either side of the valley and exploratory drifts driven toward the middle of the valley to the soft-ground filling. This method of exploration furnished a complete profile, the shafts and drifts being continued to the lowest point of the inner gorge and below, as indicated in the section. It was also found that the inner gorge for much of its length follows a fault plane, with a vertical throw of the strata of about 130 ft. Along the contact of this




VALLEY SECTION AT WAGGITHAL DAM

Rock profile explored before construction by tunneling. Dam built on top of arch thrown across inner gorge, and space below subsequently excavated and concreted.

fault the rock was much crushed and distorted, though it retained its coherence and proved to be sound and tight. It is believed that the inner gorge was formed by the cutting action of the stream, following the line of the weakened rock at the fault plane contact, while in the subsequent glacial period the upper part of the gorge was widened into U-shape by glacial action.

Because of the depth of the inner gorge, the construction of the dam was handled in a rather unusual manner. Excavation for the base of the dam was carried down only to the top of the inner gorge, 80 to 100 ft. below ground, and here an arch was thrown across the inner gorge, abutting against its vertical walls. Above this arch the body of the dam was concreted and the dam carried up. Subsequently the earth-filled gorge under the dam was entered by a shaft and tunnel, and was cleaned out to sound rock on the entire length of the foundation under protection of the concrete roof formed by the dam. All rock faces of the gorge were washed down clean, and finally the opening was concreted, through shafts left in the dam for the purpose.

# Principles of Four Kinds of Flow in Settling Basins

## Effect on Sedimentation in Straight-Line, Radial, Rotary and Spiral Inward-Flow Basins With Evaluation of Each

By Wynkoop Kiersted
Consulting Engineer, Kansas City, Mo.

FOR MANY years commercial exploitation has served on the one hand to obscure the merits of the settling basin and on the other hand to exalt and exaggerate the value of the rapid filter and its mechanical appliances. The filter plant has even been made the show part of a water-works and credited with accomplishments to which it is not justly entitled. This is because of the spectacular contrast between the sparkling brilliancy of the filter effluent and the dullness of the coagulated influent water—an accomplishment effected merely by straining out coagulated sediment by means of a body of selected sand.

The writer would limit the function of the mechanical filter to a mere straining process intended to remove a turbidity which cannot be otherwise satisfactorily and more economically removed. The burden and the intelligent and skilled supervision of the process involved in water purification relate to the preparation of water for filtration. This preparation of turbid river water must be accomplished in the settling basin.

*Straight-Line Flow*—Water introduced across the full length of one end of a rectangular basin in such a manner as to insure a uniformity of velocity in both horizontal and vertical planes and removed at the opposite end by an equally broad outlet, is the ideal straight-line flow. While only an approximation to the ideal flow is possible, still careful designing of inflow arrangements will effect a close approximation. If in addition the basin is covered, the conditions which originate and promote temperature convection currents will be eliminated as far as practicable.

The dimensions of such a basin will depend upon the practical limitations of broad distribution controlling the width and upon topography and gravity waste controlling the depth. These two dimensions once fixed, the length of basin and the detention periods are controlled by the time required for heavy particles to settle and to be moved mechanically to the waste, or for coagulated sediment to settle and to be conveyed mechanically or hydraulically to the waste. The wide difference in the hydraulic value of the sand and clay sediments and the corresponding difference of the requisite detention periods entail the handling economically of the two classes of sediment in separate basins or in separate divisions of the same basin and the removal of the deposits by independent appliances.

*Radial Flow*—Radial flow in a circular basin is deceptive as to its advantages. The hydraulic principle embraced in this kind of flow is that the velocity of flow varies inversely as the radius. Therefore, a rim outflow of water is at the vertical cylindrical section of minimum radial velocity and the deposited sediment naturally grades itself hydraulically from the center outward. The heaviest sediment is deposited around and near a central waste. These seem like strongly outlined advantages, but the influence on sedimentation of the velocity of flow in a horizontal plane is negligible. The length of travel for the water is a minimum and may be too short for satisfactory sedimentation. However, the controlling disadvantage of radial flow, either outward or inward, lies in the fact that either a converging or diverging flow must produce eddies and swirls. It cannot be straight-line motion except in shooting filaments for a limited distance. The character of flow is better adapted to the mixing tank or reaction basin wherein sedimentation is not desired.

*Rotary Flow*—If water is somewhat violently rotated with a paddle in a stationary vessel and sand is dropped into the rotating water, it will be observed that the grains of sand whirl and draw toward the dead center of the rotating water and there come to rest. The hydraulic principle involved in the rotating water is identical with that of wheel rotation so far as the rotation of a liquid can be made to conform to that of a solid, namely, that the velocity of a rotation varies

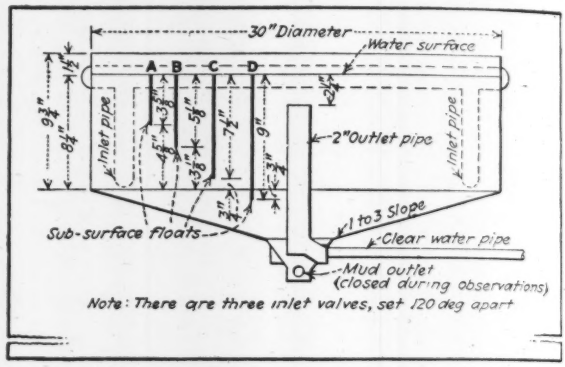



FIG. 1—EXPERIMENTAL SPIRAL-FLOW TANK
Tank belonging to James W. Pearl in which float experiments to determine spiral flow noted in curves were made.

directly as the distance from the center of rotation. This principle of rotation has no application in the design and operation of settling basins. It is only considered because of the fact that the observed action of sand or other heavy sediment in the rotating water is believed to have inspired the patentees of certain mechanical appliances. The Gathmann patents claim that the application of the rotary-flow principle in a closed steel pressure cylinder with tangential water inlet and outlet in different horizontal planes would clarify and purify turbid water. The waste pipes at the apex of the coned top and bottom of the pressure tank were expected to relieve the tank of both light and heavy impurities, forced to the vertical axis of the cylinder by rotary flow. The same observation of sand movement is believed to have inspired the vortex whirls which are understood to have been installed in one water-works without substantial success.

Failure of these appliances to work as anticipated is due in part to a misconception of the hydraulic principles involved. In the wheel rotation above described the equilibrium of quiet water has been disturbed by the use of a paddle. The work expended with the paddle is transformed into actual energy of the rotating water. Since the velocity of rotation varies directly as the distance from the center, it follows that the actual energy of rotation becomes zero at the center of rotation. Consequently, when sand is dropped into rotated water, each grain is hit by unequal forces and made to whirl, and thus repeatedly hammered. As it is

carried along in the rotating fluid, it seeks a condition of rest and equilibrium by following the line of least resistance to the dead center of rotation and remains there. When for the paddle as a force to produce rotation there is substituted pressure water introduced tangentially at the rim of a tank, and an outlet for the water provided at the center of the vessel, the hydraulic principles involved become either modified or reversed. This brings up the interesting topic of spiral inward flow.

*Spiral Inward Flow*—If water is introduced into a circular basin tangentially at the rim through several openings and taken out through a vertical shaft at the center it will rotate and will reach the outlet by inward spiral flow. It is evident that the velocity of rotation must increase as the center of the basin is approached. The hydraulic principle involved is that the velocity of rotation varies inversely as the distance from the center. The principle is the reverse of wheel rotation.

The increasing actual energy of the rotating water inward tends to force particles outward or toward the rim of the tank. The predominating force in the potential energy of the entering water is inward. The resultant of the two forces is an inward spiral movement. A float placed in the rotating water completes many circuits before reaching the outflow vortex. Either a surface or submerged float will move toward the rim abruptly if the inflow water be slightly decreased, and the reverse abrupt movement inward is noticed if the inflow be slightly increased. This manipulation of inlet flow disturbs the balance temporarily of the two conflicting forces, and correspondingly disturbs the regularity of float travel until the balance or continuity of flow becomes re-established. Fig. 1 shows typical velocity curves of spiral inward flow from float observations made in a model of the Pearl rectifier.

The free spiral vortex movement, which this rotary flow is, consists of a combination of inward radial flow and free circular flow. It has been stated that converging radial currents moving inward at an increasing velocity promote swirls and minor vortices. This effect is softened by the spiral direction of flow resulting from the circular motion. Therefore better results of sedimentation may be expected in spiral flow than in a direct radial-flow tank.

When these principles of flow are introduced in a circular settling basin, the sediment in the water will encounter the same conflict of forces as do the floats before described with the result that sedimentation will take place throughout the tank and the sediment will grade hydraulically, but less uniformly than in radial flow. Further conflict of currents and a consequent disturbing effect on sedimentation may be expected within the range of influence of the control discharge vortex where undoubtedly flow and perhaps high velocities in vertical planes may be expected. A helical upward flow around the central outflow shaft will take place unless counteracted by a bell-mouth inlet to the shaft or other similar expedient.

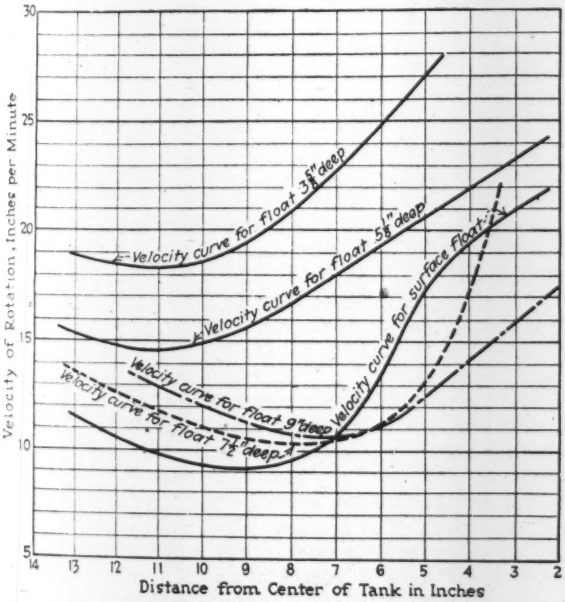

Velocity of Rotation, Inches per Minute
30
25
20
15
10
5
Velocity curve for Float 3½" deep
Velocity curve for Float 5⅛" deep
Velocity curve for surface Floats
Velocity curve for Float 9" deep
Velocity curve for Float 7½" deep
14 13 12 11 10 9 8 7 6 5 4 3 2
Distance from Center of Tank in Inches

FIG. 2—VELOCITY CURVES FOR VARIOUS FLOATS IN SPIRAL-FLOW TANK

Curves deduced from experiments made by J. W. Pearl with constant water level and a 13.1-in. overflow per hour, total 40 gal. per hour.

FIG. 3—DISTRIBUTION OF FLOC PRODUCED BY SLOW SPEED OF 1 HR. THROUGH LABORATORY MODEL

Scattered lace-like floc at circumference increases toward center to solid at 7½ in. diameter circle heavy enough to slump into sump at center. The radial streak was caused by a leaky valve discharging when model was put on side for photographing.

*General Observations*—Since velocities in a horizontal plane do not affect sedimentation, it follows that the best form of flow is one which creates the least vortex and convection current movements with their attending vertical velocities, or that form of flow in which these tendencies can be suppressed to the greatest degree by simple mechanical devices. Difficulty will be experienced in suppressing swirls in a radial-flow tank. When suppressed by a wire net at one cylindrical section of the tank, they reform beyond the screen. The same is true of spiral inward-flow tanks to a less degree. Both kinds of flow possess mixing qualities adaptable to chemical mixing and reaction basins.

In straight-line flow the suppression of swirls and vortices is more readily accomplished than it is in other forms of flow by broadcast screened inlets or other similar device.

# From Job and Office

## *Hints That Cut Cost and Time For the Contractor and the Engineer*

### Heavy Pipe Laid by Simple Means

By E. F. Mail
Civil Engineer, Robinson, Ill.

THE accompanying photograph shows a well known application of power that is all too seldom seen in use on construction jobs. The sewer is 36-in. vitrified clay pipe, in 3-ft. sections, each section weighing approximately 1,200 lb.

In laying this tile, a 4-in. wrought-iron oil pipe spans the trench and at each end rests in grooved timbers. Three sets of pipe tongs and two rope slings complete the equipment. One sling is used for lowering the tile into the trench, and the other is so placed in the trench that the center of it comes approximately under the center of the newly lowered tile.

TONGS, SLINGS AND SMALL PIPE COMPOSE THIS PIPE LAYING EQUIPMENT

The free ends of the latter sling are then turned three times around the 4-in. pipe, and held taut in the hands of the man on the last laid tile. One man uses one set of tongs as a brake, and two men, one at each end of the iron pipe, use the other two sets of tongs to turn the pipe and raise the tile. When the tile is raised sufficiently, the two men in the trench push the spigot end into the bell of the last laid tile, the man with the running ends of the sling slacks off, and the tile is laid.

A total of 372 lineal feet of 36-in. tile were laid for a total cost of $85 or approximately 23c. per foot. Labor was 40c. per hour. Six men and a foreman were sufficient to lay the tile, but as no snubbing arrangement was used, three additional men were used to place the tile in position near the trench and to assist lowering it into the trench.

The engineer was E. F. Mail, assisted by S. P. Andersen. The contractor, L. W. Skidmore, learned the method while handling heavy weights on oil pipe-line construction.

### Sawmill Fuel House Built of Concrete

By E. L. Crowe
Division Engineer, Sessions Engineering Co., Chicago, Ill.

CERTAIN unusual features of design and construction were brought into play in connection with the fuel house designed and built by the Sessions Engineering Co. of Chicago for the Crossett Lumber Co. at its Crossett, Ark., mills. The structure serves as a storage house for the wood refuse from the sawmill and planer mill operations, which is used for fuel in the six 500-hp. boilers in the adjacent power plant and, with its capacity of 750,000 cu.ft., provides a reserve of fuel for Sundays and holidays when the sawmills are shut down.

Due to the limited space between the boiler room and a tram carrying heavy traffic, the inside dimensions were established as 36 ft. by 160 ft., and the height of the bottom chord of the roof truss from the floor was made 42 ft. to gain the cubical contents required. Ten bays of 16 ft. each comprise the length to conform to the boiler house and to permit of future extensions of both buildings.

It was a matter of prime importance that this building be fireproof as well as weather proof, and after past experience with a large number of fuel houses and vaults and following studies of various type of buildings as to cost, durability and facility of construction, a reinforced-concrete structure was decided upon.

No accurate data excepting as accumulated by the experience of the engineers are known to be available as to the lateral pressure caused by the expansion of strata of wood refuse fuel with an excessive content of moisture coming from wet timber at the band saws. Such strata are liable to occur at any elevation and the expansion pressure transmitted to any part of the walls in addition to the uniform lateral pressure arising from the upper layers of fuel considered as a granular mass. Also there was the possibility of the presence of a quantity of water in the event of action of the fire sprinkler system to be installed along the roof trusses. A peculiarity of the fuel, consisting of sawdust, shavings and hogged refuse, is its tendency to arch, the angle of repose frequently becoming as high as 90 deg., and the resultant thrust, of course, depending on the height of the fuel above and the rise and spring of the arch.

For these reasons any eventuality was taken into account by calculating the stresses in the structure on the basis of its being completely filled with a liquid weighing 25 lb. per cu.ft., which is the approximate weight of the wood refuse when packed. To these stresses were added the normal resultant from the roof load and wind. The arching effect makes interior tie-rods or cross-bracing impractical and the design resolved itself into a combination of structural steel framework with reinforced-concrete walls.

*Design*—The roof trusses are symmetrical, a modification of the Fink forms and carry a monitor 12 ft. wide running the full length and purlins for supporting

the cement tile roof which has a slope of 30 deg. The monitor encloses a 36-in. belt conveyor and its motor drive and is fitted with metal sash and wired glass ground to prevent combustion of the fuel by any lens effect. The two east trusses carry also a tower, the top of which is 72 ft. from the ground and on which are mounted the cyclone collectors discharging fuel onto the conveyor in the monitor.

Built-up columns, consisting of ¼-in. web plate and 6x4x2-in. angles with horizontal stiffener angles and ¾-in. bearing plate, perform the double duty of supporting the roof trusses and the load of fuel transmitted by the walls of each bay. The columns taper on the outside face from 4 ft. at the bottom to 8 in. at the top and are covered with concrete to form buttresses 16 in. wide. Two anchor bolts 1¾ in. in diameter are provided for each column. Four such buttresses are at either end of the building in addition to eleven on either side. A horizontal strut extending all around the structure at the critical point has braces to the outer face of the column to provide for shear. These, with the usual struts and sway bracing are the only members in the framework aside from knee braces at the north side columns running from a point 9 ft. above the base to a longitudinal concrete pier to which they are anchored.

The walls were figured as simple beams with a span of 16 ft. and reinforced rods provided at intervals, increasing from 9 in. as the load becomes lighter toward the top. These rods are wired to holes punched in the inside angles of the columns. Vertical rods for temperature were located in each bay. The walls are vertical on the inside and are tapered from a width of 12 in. at the bottom to 6 in. at the top (the end walls are 10 in. at the bottom because of the shorter span of 11 ft. 6 in. between columns).

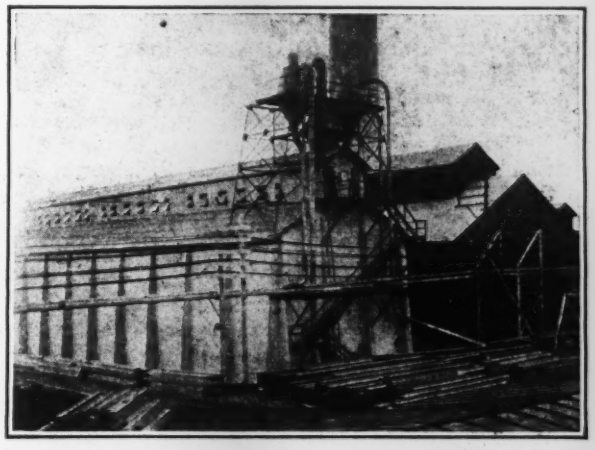
Inside the concrete walls of the fuel house is a framework of heavy timber supporting six V-shaped bins whose sides are at an angle of 55 deg. to the vertical to assure a free flow of fuel to the bottom where there are gates opening onto chain conveyors, one for each boiler. Both bins and conveyors slope up to the north toward the power house to gain a sufficient elevation to drop the fuel into the boiler spouts. It is the consequent unequal loading of the north and south walls due to the difference in elevations of the bottom of the bins that made it necessary to provide the knee braces mentioned earlier.

*Construction*—The structural steel framework was erected complete and utilized in pouring the concrete walls. The forms were made up in sections the width of a bay and 10 ft. 6 in. high of 2x6-in. tongue and groove pine with 3x5-in. oak battens, 4x6-in. pine walings and bolts for holding the two sides in place. Separate similar forms were made up for the buttresses. Twenty-four sets of these forms were built so that by the time the concrete had been poured in the last forms set the ones used earlier had been removed and were again available. By this method one bay was completed in four pourings.

The reinforcing rods were ordered bent at the mill and were wired in their proper places before the forms were set. With the rods thus taken care of and using the steel framework to support the forms it was possible to eliminate scaffolding altogether, the resulting saving being obvious.

A mixing plant was built at the west end of the building together with an elevator tower equipped with two ½-yd. side-dump cars. A 24-in.-gage track was laid in the monitor and the concrete carried to any part of the building as required and dumped into chutes leading to the forms. A switch was installed so that one car could be loading while the other was dumping. This arrangement permitted the handling of a maximum amount of concrete in a minimum time with a small amount of labor. This aim was imperative because of the rapidly approaching completion of the power plant and, in fact, the work of setting forms, pouring concrete and removing the forms was accomplished in forty-five working days. The mix was 1:2:4.

Thirty-six hours after the walls had been poured the forms were removed and the outside surface was gone over with stone until the board marks were taken out and the sand brought to the surface, then the walls were washed and white cement applied, giving a clean



CONCRETE FUEL HOUSE AT CROSSETT, ARK.

surface of soft texture and making an attractive building in place of an unsightly one, which is rather the rule for buildings devoted to a like use. The fuel house has been completely filled and emptied several times without a sign of a crack having developed.

## Map Aids Explanation of Street Improvements to Lay Body

By Tom V. Bogy
Principal Assistant City Engineer, Helena, Mont.

THE engineering department of the city of Helena was recently called upon to tell the commercial club at its annual meeting what had been accomplished in street improvement work. As a usual thing talks of this kind run into great detail, and even with the aid of the ordinary map, people are not vividly impressed. Our auditors knew the location of the streets in a general way, yet it was up to us to show them definitely the location of the improvements.

After a little discussion we decided upon an illuminated map. We made a tracing of the major portion of the city, showing the important points and including the improved streets, on linen tracing cloth. The tracing was mounted upon a piece of compo board having the improved streets cut out. Over the cut-outs, and between the board and the tracing, we pasted sheet gelatine of different colors, the colors designating the various types of pavement. The streets formerly improved were also cut out but left uncolored. On the

back of the board, over the cut-outs, we pasted black friction tape to shut out the light. About 3 ft. back of the map we placed a stage box flood light. As the talk progressed and as each street was mentioned the tape was removed from that street in the manner in which it had been paved, from the place of beginning to the finish. The proposed work for next season was also shown in color. The map was placed at the rear of the speaker's platform with the back drape hung around it; making it impossible to see one of our men as he removed the strips of tape.

The map can be made at a small expense and where a talk of this kind is required will serve the purpose very well. It could be made on an elaborate scale if the time was available. Holes could be punched through the board allowing the light to come through representing street lights and cut-outs represen'ing the sidewalks and park strips could be made very easily in appropriate colors.

## Reconstruction of Track Floor in a Railway Terminal

FLOOR ALTERATIONS have been made necessary in the double-deck passenger terminal station of the Pittsburgh & West Virginia Ry., at Pittsburgh, Pa., as the first floor, under the trainshed, is utilized for

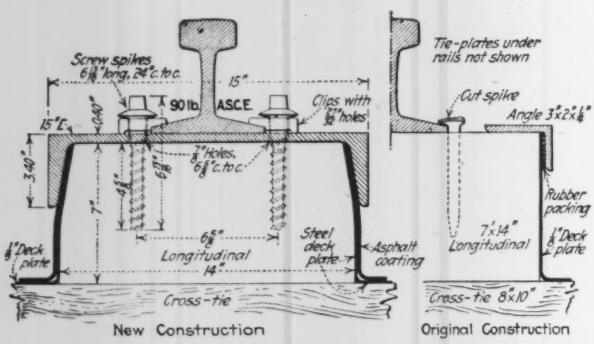



FIG. 1—ORIGINAL AND IMPROVED TIMBER DECK

store rooms and there has been considerable difficulty in keeping the older part of the upper deck watertight. There are six stub tracks and three island platforms in the station.

In the original structure, built in 1904-05, an unusual type of construction was employed for the second floor or track deck. As shown in Fig. 1, the rails were carried on longitudinal timbers 7x14 in., resting on 8x10-in. ties spaced 30 in. apart and placed across plate-girder track stringers in the steel floor framing. The ties were 12½ ft. long for single track and 23 ft. for double track. All the timbers were creosoted. Upon the ties was laid a deck of ⅜-in. steel plating, the plates being bent up against the longitudinals and fitting under 3x2-in. angles spiked along the corners of these timbers. Rubber packing was placed between the bent plate and the angle.

At the platforms, the deck sheets were bent up in the same way and lapped under a copper flashing plate on the face of the platform, the top of this plate being bent to lie on the planking of the platform, where it was covered by asphalt flooring. Transverse gutters were placed in the track deck at intervals and connected to downspouts. The steel deck plate between the

# From Job and Office

## *Hints that Cut Cost and Time*

rails was painted with asphalt but corrosion and distortion caused considerable trouble, the principal difficulty being the entrance of water working under the angles along the edges of the longitudinals.

Reconstruction of about half the floor of the trainshed was carried out after a fire in 1918, all the timber framing of track and platform being replaced with steel framing, as shown in Fig. 2. The long crossties are 8-in. I-beams spaced 28¾ in. c. to c., carrying longitudinal 10-in. H-beams having the rails bolted to the top flanges. A reinforced-concrete floor with membrane waterproofing was filled in between the I-beams and sloped up to the H-beams, as shown.

A recent examination of the remaining part of the timber floor showed that it is still in first-class condition and it was decided therefore to make it watertight rather than go to the expense of reconstruction. For this improvement, shown in Fig. 1, the longitudinal timbers will be beveled slightly to fit a continuous 15-in. 33-lb. steel channel laid on top and electrically welded at the joints. The steel sheets of the deck pans between the rails and between the tracks will be bent up to the full height of the timber, fitted under the flanges of the channels and covered with ⅛ in. of asphalt mastic mopped with waterproofing cement. This asphalt coating will extend entirely across the plating. The rails will be laid directly on the channels, but the present cut spikes will be replaced with screw spikes and clips, as shown. The old cut spikes were driven in bored holes to prevent splitting the timbers and these holes will be carefully plugged. The screw spikes will be dipped in self-healing cement before being put into newly-bored holes.

Both the present improvement of the timber deck,

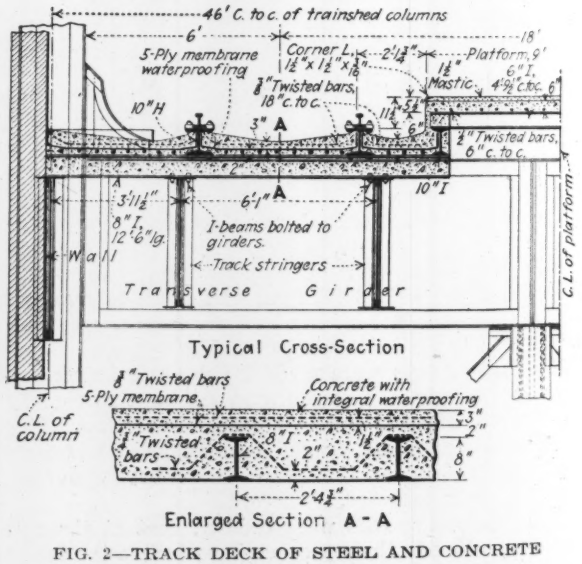



FIG. 2—TRACK DECK OF STEEL AND CONCRETE

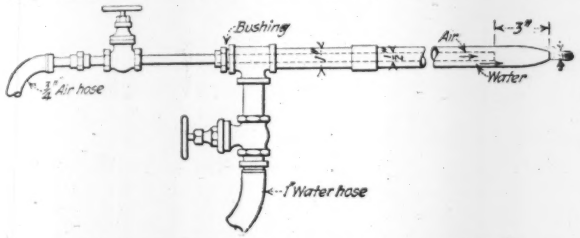
which is to be carried out this year, and the earlier steel reconstruction, were designed by H. H. Temple, who is chief engineer of the Pittsburgh & West Virginia Ry.

# From Job and Office

*For Contractor and Engineer*

## Air and Water Jet Cleans Concrete Surface for Next Pour

IN THE construction of the Weid Canyon dam which is being built by the city of Los Angeles as part of its water distribution system, a combination air and water jet has been developed which has proved to be a very effective means of cleaning off concrete so as to




DETAILS OF THE NOZZLE, SHOWING AIR AND WATER PIPES

afford a rough, hard surface free of all foreign matter, and a good bond for the next concrete to be poured. The device consists essentially of two pipes one within the other whereby the spouting velocity of the water issuing from one of the pipes is increased by the compressed air issuing from the other pipe.

Air and water are brought to the device in rubber hose of ¾- and 1-in. diameters, respectively, the water being under heads ranging up to 300 ft. and the air under a pressure of 90 to 100 lb. per square inch. The air hose terminates in a ½-in. pipe inside a 1-in. pipe which carries the water, the relative position of the two outlets being arranged as shown in the accompanying sketch. The over-all length of the pipe-nozzle is about 4 ft.

Two men are used to operate this device, one to manipulate the nozzle and a second to drag the hose so the operator can work to best advantage. The effect of the combined air and water jet is to leave the surface remarkably clean with rough, sharp corners where all small particles not firmly embedded have been washed away. Most of the water used in washing flows off because the surface of the concrete is kept sloping downward toward the upstream face of the dam. Pools which form from the water collecting in hollows are bailed out and wiped up before concrete pouring begins.

COMBINED AIR AND WATER JET IN OPERATION

The work on Weid Canyon dam is under the general direction of William Mulholland, chief engineer, Los Angeles Bureau of Water Works and Supply. H. L. Jacques, who developed the jet described in the foregoing, is superintendent of construction.

## Illuminated Street Signs for St. Louis

THERE HAVE recently been installed in University Heights, St. Louis, twelve street guide posts which comprise the first of a series to be erected. In those sections of the city where these are installed maples overhanging the sidewalk make the ordinary curb street guide posts practically indistinguishable at night, so these new posts are set at strategic points where they are visible to drivers from practically every direction.

The guide post comprises three principal elements: The concrete base, cast-iron standard, and luminaire, or lighting fixture portion at the top. Concrete cast in conical form above the street grade, and extending cylindrically for 2 ft. below grade, constitutes the base. The conical sides of the base guard against injury to automobiles which might strike the base a glancing blow. The cast-iron columns are hollow, of an ornamental though standard design, and each is bolted to the concrete base by 4¾x18-in. anchor bolts.

ILLUMINATED STREET GUIDE POST

No regularly manufactured luminaire satisfied the requirements for the special lighting units, so the one finally adopted was the result of many trials. It consists essentially of a hollow sheet-and-cast-bronze box which has open sides and bottom. In the sides are inserted the glass street name panels; panels of clear glass are placed in the bottom. Over the circular opening in the top of the luminaire is clamped a 12-in. hemispherical ruby glass bowl. At night when the incandescent lamps within the lighting unit are in operation the street signs and the ruby bowl are well lighted and of pleasing appearance. Light is projected downward from the lamp through the clear glass panels to illuminate the concrete base, which is painted white. Each luminaire is held in an annular recess which forms the top of the cast-iron standard. The luminaire may be rotated to any desired position, and there held with setscrews of the standard which pass through holes (drilled on the job to fit) in the base ring of the luminaire.

Each luminaire is equipped with two 40-cp. 6.6-amp. nitrogen-filled series incandescent lamps. Connections are made to existing series street lighting circuits.

The lighting for University Heights was designed and supervised by the Terrell Croft Engineering Co., consulting engineers of University City, who are retained by the trustees of University Heights.

# Correcting the "Lean" in Aerial Photographs

## Mathematical Explanation of How to Obtain a True Instrumental Orientation When Using Air Photos as Plane-Table Sheets or for Other Field Purposes

By E. H. Corlett
Junior Engineer, War Department, Chattanooga District

FROM A VARIED experience in aerial photographic work, both during the World War and since, the writer has concluded that there is one fundamental property of the aerial photograph which is not given proper consideration. Though the effect of this factor is considerable in field use of the aerial photo (such as its functioning as a plane-table sheet) the tendency is to gloss over and underestimate its effects. This factor is the apparent "lean" of the photographic representation of tall objects away from the center of the aerial photograph. Correction of the lean is quite possible upon a mathematical basis. However, for the purposes of applying this correction to the lean let it be assumed that parallel horizontal lines photograph as parallel images, which is not always true as precise checks will indicate.

As further basis for proof of the following proposition the center of the aerial photo will be considered as the image of the point directly below the lens at the instant of exposure; and the aerial photo will be considered as a contact print used as a plane-table sheet.

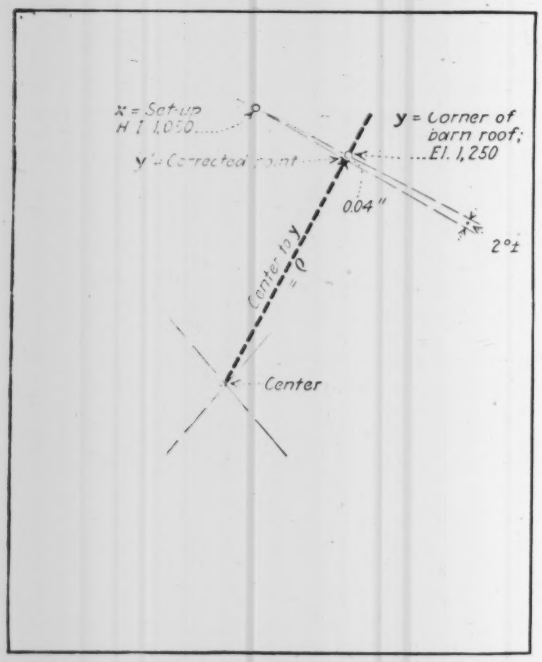



FIG. 1—CORRECTION OF AZIMUTH ON SINGLE PRINT

On a true plan the vertical components of all of the lines appear as points, but upon the print they are lines of finite dimension except at the center. To the mapper, they are of sensible length everywhere except within an area about the center whose diameter is an inverse function of the length of these vertical components and a direct function of the altitude of the lens above the mean plane of the general area mapped.

This means that there is only one place represented upon the print where one may set up, orient, and expect the edge of the alidade to line true to all objects of varying elevations—the center of the print. If one set up there, sight upon a point identifiable on the print, move there, orient by backsighting, and then sight objects about him whose elevation differed materially from his, he would find that the line determined by his photographically-represented setup and the image of the point sighted would pass without the space between the point itself and the object represented on the print as the center if the object sighted were higher than his H. I., and within this space if the object were lower.

There are three ways to obtain a true orientation:

(a) In completing a setup, choose a horizontal orientation sight.

(b) In completing a setup, choose a radial-to-print-center orientation sight.

(c) Assume neither of the above two solutions applicable and that the observer is at $x$, which is lower than $y$, upon which he expects to base his orientation, by $h$ feet. The altitude of the lens in feet above the observer is the product of the focal length of the lens in inches and the scale in feet per inch of the horizontal plane through the observer, as observed upon the print considered. In the following the altitude of the aerocamera need be known within only rather wide limits, though as their ratio of relief to altitude increases these limits are narrowed and the measure of the altitude must approach a definite quantity.

As the lens of the aerocamera generally used in aerophotography has a focal length of about 12 in., we shall assume the altitude as the product of 12 and the scale. Draw a radial line through $y$. Call the distance in inches from the center of the print to this image of $y$, $\rho$. Then lay off on this radial line and from the image of $y$ toward the center a distance, in inches, thus determined and called $d$.

Then $$\frac{\rho\, h}{12 \times \text{Scale}} = d$$

This determines the numerical value of the "lean" of the image of $y$ away from the imaginary image of the base of a perpendicular from $y$ to the horizontal plane through $x$. Call the new point, between the image of $y$ and the center of the print $y'$. Then, if an orientation be based upon the image of $x$, $y'$, and $y$ itself, the print is truly oriented, and a magnetic meridian thereupon laid out will check every other magnetic meridian laid out by processes (a), (b), or (c).

Refer to Fig. 1 to see how badly a pseudo-orientation will throw one off on meridian. Assume the corner $y$ of the roof of a barn to be of elevation 1,250, and to be 3 in. away from the center of the print. Suppose the instrument to be at $x$ and 1,500 ft. away from the point $y$, and on a line roughly at 90 deg. to the radial through $y$, and to have an H. I. of 1,050. This gives us an $h$ of 200, a $\rho$ of 3. Assume the scale on the (horizontal) plane through $x$ to be 1,250 ft. = 1 in. These factors give us a $d$ of .04 in. which covers 50 ft. at the scale used. Fifty feet in 1,500 represents 2 deg. of arc.

It will of course be apparent that if $y$ be lower than $x$, the correction must be applied in the opposite direction. This brings us to the case where both may be shifted so as to locate them correctly with respect to the center of the print on any plane and to any given scale.

The final example used will be the transference from one print to another and overlapping print a line of

known azimuth. We shall later choose two points in the overlap area, the line on the ground between which bears a known relation to the line of known azimuth just mentioned; and the transfer of the line between these two points will be the actual demonstration.

Consider two prints $M$ and $N$ (Fig. 2). The scale observed on $M$ is 1,180 ft. = 1 in. on contour 1,050;
on $N$ is 1,320 ft. = 1 in. on contour 1,210.

Therefore the respective altitudes of the aerocamera are:
For $M$: (1,180 × 12) = 14,160; add 1,050: 15,210;
For $N$: (1,320 × 12) = 15,840; add 1,210: 17,050.

This gives us a difference of 1,840 ft., meaning that on $N$ contour 2,890 would yield a scale of 1,180 ft. = 1 in. and on $M$ contour —630 would yield a scale of 1,320 ft. = 1 in. Suppose the two points previously mentioned and here

Now, if we wish to obtain a representation of the base of a perpendicular from a point to a plane lower than the point, this base will appear nearer the vanishing point (center of the print) than will the representation of the point itself, and conversely. Therefore $d_{1M}$ and $d_{2M}$ are laid off toward and $d_{1N}$ and $d_{2N}$ away from the center. Simply, as in our demonstration the scale in feet per inch is larger (that is, of smaller numerical value) on $M$ than on $N$ on any plane common to both, corrections of plane figures determined by images must be toward the center on $M$ and away from the center on $N$ in order to bring these figures into equality of linear and angular scale.

The net result of these operations (which take much less time in the doing than in the telling) is two lines,

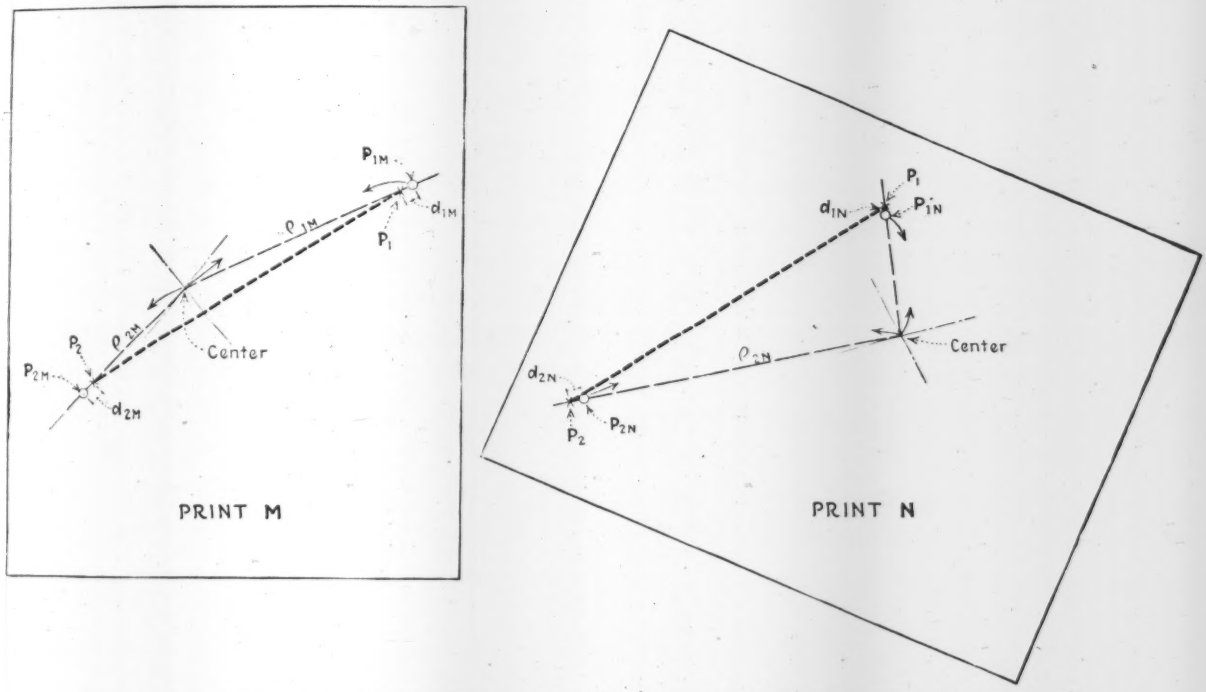



FIG. 2—METHOD OF TRANSFERRING KNOWN AZIMUTHS FROM ONE PRINT TO ANOTHER

designated as $P_1$ and $P_2$ are of elevation 1,020 and 1,350, respectively. Assume $P_1$ to be 3.2 in. ($\rho_{1M}$) from the center of $M$ and 1.6 in. ($\rho_{1N}$) from the center of $N$, and $P_2$ to be 1.9 in. ($\rho_{2M}$) from the center of $M$ and 4.1 in. ($\rho_{2N}$) from the center of $N$. Let us assume a datum plane for each print which will yield a scale of 1,250 ft. = 1 in. (the scale of the survey of the Tennessee). This means that we must choose planes 15,000 ft. below the lens at the respective instants of exposure. On $M$ this will be contour 210 and on $N$, 2050. Therefore, $P_1$ will be 810 ft. ($h_{1M}$) above the datum of $M$ and 1,030 ft. ($h_{1N}$) below the datum of $N$. $P_2$ will be 1,140 ft. ($h_{2M}$) above the datum of $M$, and 700 ft. ($h_{2N}$) below the datum of $N$. Then the formula gives us these:

$$\frac{\rho_{1M}h_{1M}}{\text{Altitude}} = \frac{3.2 \times 810}{14{,}160} = d_{1M} = 0.18 \text{ in.}$$

$$\frac{\rho_{2M}h_{2M}}{\text{Altitude}} = \frac{1.9 \times 1{,}140}{14{,}160} = d_{2M} = 0.15 \text{ in.}$$

$$\frac{\rho_{1N}h_{1N}}{\text{Altitude}} = \frac{1.6 \times -1{,}030}{15{,}840} = d_{1N} = 0.10 \text{ in.}$$

$$\frac{\rho_{2N}h_{2N}}{\text{Altitude}} = \frac{4.1 \times -700}{15{,}840} = d_{2N} = 0.18 \text{ in.}$$

one on $M$ and the other on $N$, which are true plan representations to 1,250 ft. = 1 in. of the line connecting the objects of which $P_1$ and $P_2$ are the images; and these lines will be of equal length, and of equal azimuth by any proper system of determination, well within the limits of field accuracy.

We may deduce from the foregoing that the task of transference may be shortened thus: Select a line for transference which passes through the images of both centers, if both show, each on the other. It may be that both should show, but for some reason, clouds, shadows, hazy woods, etc., that they do not. In this case, select a line through the center of $M$ so as to cut two points which appear on both $M$ and $N$. Then on $N$, select a plane through one of the points. Of course this does not reduce the two lines to the same scale, and, therefore, may not be so desirable a short-cut. It will also be observed that if the $N$ altitude be used where the $M$ altitude should be used, the error is only about 10 per cent in the $d$ values; and as these altitudes are safely the extremes one is likely to meet, the average elevation of a flight may be used—generally introducing an error of not more than .01 in. in applying the correction.

# Letters to the Editor

*This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.*

## Further Study of Portland Cement

Sir—In your issue of Aug. 21, J. Y. Jewett, referring to my article on "Some Requirements in the Study of Portland Cement" (July 17, p. 105) expresses the opinion that the neat tensile test is of doubtful value. The writer is in complete accord with this view for the case in which the cement is mixed to the so-called "standard consistency." When, however, the ratio between water and cement in the neat briquets is the same as that in the sand specimens then the neat test discloses characterictics which, in the presence of an optimum 25 per cent of water, are completely hidden.

Nathan C. Johnson in the issue of Aug. 21 very forcibly emphasizes certain of the causes which, singly or in combination, may operate to cause the disintegration of concrete. Mr. Johnson's statement that the processes which occur during setting have " * * * even been made visible * * * " is deserving of more than passing notice because it seems to forecast an early and definite advance in our knowledge relating to one of the least understood of the causes which impart to cement its most valuable properties. If, as Mr. Johnson indicates, the setting of cement can be retarded or accelerated at will, a long step in advance will have been recorded. And if it becomes possible not only to arrest the disintegration of concrete, but to restore concrete which has begun to disintegrate, it should, by the same token, be possible to make concrete which would not require either cure or restoration.

In these matters Mr. Johnson has gone to the very essence of the major problem which presses for solution. His results will be eagerly awaited by manufacturer and user.

New York, Aug. 23. THADDEUS MERRIMAN,
Chief Engineer, Board of Water Supply.

## Pittsburgh Plus and Chicago Base Price

Sir—Your comment on p. 276 of your August 14 issue is not quite correct. The Pittsburgh plus decision includes the findings and the order, also the dissenting opinion. The reference to a common price at Chicago and Pittsburgh is found in the findings and is therefore a part of the decision although not a part of the order; you are correct in saying that it is part of the argument. The Federal Trade Commission has assuredly presented an argument and not much else; it seems to be based on the theory that price should be determined by cost plus a profit rather than by supply and demand and competition.

To show the absurdity of trying to fix prices on the basis of cost, let us assume two fields of corn of equal production and of equal cost up to the time of harvest. Just prior to harvest a flood destroys three-fourths of one crop. Then that crop must sell for $4 a bushel while the other crop sells for $1 a bushel. Of course no one will buy the $4 corn until all of the $1 corn is exhausted; and there would probably be a spirited protest!

In your issue of July 24, p. 154, you said: "The commission estimates farmers of 11 western states have an extra steel bill of $30,000,000 yearly to pay because of the base plus plan." But the findings state that this estimate is based on the Chicago base price being the same as the Pittsburgh base price for the mills of the United States Steel Corporation. If the price at Chicago is not fixed at the same price as at Pittsburgh by this decision, should you not correct the erroneous impression in that news item?

The petition of the Chicago fabricators to the Federal Trade Commission asked that the price at Chicago be made as low or lower than the price at Pittsburgh. It also asked that the price be based on cost plus a reasonable profit.

Indianapolis, Ind., DANIEL B. LUTEN,
Aug. 19, 1924. Consulting Engineer.

## Engineer's Perspective Needed

Sir—The engineers of the country have been asked to assist, and are co-operating to a considerable degree, in the solution of various questions affecting the public welfare, especially city planning and standardization of manufactured products. Undoubtedly, by virtue of their training and work, engineers are well equipped to render material assistance along such lines.

While it is not probable that engineer members of special commissions will be so over-influenced by popular clamors for a "city beautiful" or for radical reductions in sizes and types of manufactured articles as to lose sight of the economic needs of the community and industry, yet an occasional view of the other side of of the picture may assist in retaining a proper perspective. It is with this in view that the following points are suggested.

*City Planning*—Many cities and large towns have under way a movement to eliminate all commercial enterprises from certain large areas which are to be reserved exclusively for residential development. In some instances, these areas are so extensive that the advantage of an occasional small and convenient shopping center is lost. Our department stores and other centralized merchandizing establishments have done much to drive the small trader out of business. This has its advantages as there can be no doubt of the objectionable features of a community in which residences and commercial establishments are indiscriminately mixed, but we have not yet reached the point where the ordinary community can afford to do away entirely with the convenience of the corner drug store, the market, or the neighborhood general store. While not ideal in its arrangement and distribution, the Hyde Park district of Chicago well illustrates the convenience to the ordinary householder of the occasional small commercial centers, placed at reasonable intervals.

Comprehensive zoning plans, prepared to meet the needs of an entire city, do not frequently ignore such points, but efforts which are more local, and which aim at the development of certain definite portions of a city, are quite apt to result in a distribution of facilities which will not make for the economical development of the city as a whole.

*Standardization of Manufactured Products*—In the movement to secure economy in production, with the idea that at least a part of such economies will be passed on to the consumer, engineers are taking an important part. While no evidence has been noted of extreme limitation of types and sizes, there is a possibility of loss of important advantages if due consideration is not given to the detailed uses of the products. For illustration, take some of the specialties of the paint trade. One concern which specializes on a very high grade enamel markets this product in a large assortment of containers, some of which must cost nearly as much as the material which they contain. The pint package is a tin can of especially sturdy construction and attractive design, equipped not only with the usual compression top but also an extra screw top. Considering the fact that the same material is offered in half-pint bottles and in quart cans, the ordinary investigator might decide that this special pint package is unnecessarily expensive and should be discarded, but if the progress of this special package to its final destination and use is followed, the decision might be reversed. The purchaser of such a package of high grade material probably requires it for "touching up" a piece of furniture and will open it a dozen or more times before it is all used, and thus the extra expense involved in the sturdy construction and the airtight features may result in real economy to this purchaser.

The intelligent co-operation of manufacturers, dealers and large users of engineering supplies usually can be secured in the consideration of such problems as the reduction in cost of manufacture and marketing but that of the small user is more difficult. For this reason, it is suggested special care be exercised by those advocating standardization, to make sure that sizes and types to be discarded may not be essential to economy, not necessarily of production but of production and use, and that investigations along such lines be carried through to the ultimate consumer.

ARTHUR M. SHAW,
New Orleans, La., Consulting Engineer.
July 28, 1924.

# News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

## News Brevities

**A City Manager Movement** at Trinidad, Colo, was defeated on July 30 by a vote of 1,237 against 707 for a proposal to call a charter convention. The vote was light.

**A Civic Center Site** has been bought by Camden, N. J., for $791,241. The purchase includes the 45-acre tract and buildings of the old plant of the Camden Iron Works, bounded by Cooper River, Line and Federal Sts., and Starr Ave. Pending the erection of city buildings the entire area will be used as a park.

**Reconstruction of the Norman Dam** on the Lake of the Woods is to be begun in the next few weeks according to the president of the Backus Brooks Lumber Co. of Minneapolis. The new dam will supersede one built 28 years ago and will cost several million dollars. It is being built to increase the power available for use at the company's new plant at Kenora, Ont.

**A Settlement of Several Inches** in one of the piers of London Bridge over the Thames is reported. Waterloo Bridge, nearby, was recently closed for reconstruction after alarming settlement of one of the piers (*Engineering News-Record*, June 19, 1924, p. 1059), and much additional traffic was thrown on London Bridge. There is some belief that the added traffic caused a pier of the latter bridge to settle.

**Work on a Railroad** from Zacapa in Guatemala to Santa Ana, Salvador, is to be started shortly according to press reports from San Salvador. The new line will run in a southerly direction from Zacapa to connect with the railways of Salvador and will give Salvador an outlet to the East coast on the Gulf of Honduras at Puerto Barrios. Announcement that the control of the International Rys. of Central America had passed to American interests and that such construction would be undertaken was made last spring.

**An Attempt to Recall** Ben. F. Stapleton, Mayor of Denver, Colo., failed decisively on Aug. 12. His opponent was D. C. Bailey, immediate predecessor of the present mayor. The vote was 56,000 for Stapleton and only 24,300 for Bailey, giving the former a majority of 31,300. The supporters of the present incumbent claimed for his administration a clean record as regards control of crime and much progress in the way of public improvements, and alleged the contrary of his predecessor in office. Organized labor supported the present mayor and asserted that his rival had grossly mistreated labor while in office.

## Rock Island Proposes Further Extensions in Oklahoma

The Chicago, Rock Island & Pacific Railway Co. has applied to the Interstate Commerce Commission for authority to construct a new line of railroad from Owens to Ponca City, Kay County, Okla., a distance of approximately eight miles, to be an extension of its proposed line from Billings to Owens. Application for the extension from Billings to Owens is now pending before the commission. The total distance will be about 30 miles. The new line is to develop mineral, agricultural and livestock industries, and also to reach the Tonkawa oil field.

## Typhoid Outbreak at Havana, Cuba

A typhoid outbreak at Havana, Cuba, which became noticeable the middle or latter part of June, totalled 590 cases and 99 deaths during June and July. The onset and decline of the outbreak is shown by the accompanying figures supplied to this journal on request under direction of the surgeon-general of the U. S. Public Health Service by B. J. Lloyd, assistant surgeon-general Dr. Lloyd states that on July 2 it was reported that the water supply of Havana was insufficient in quantity, necessitating a draft on the Almendares River, said to be infected. Dr. Lloyd also states that typhoid prevalence at Santiago de Cuba has been reported in connection with a deficient water supply.

TYPHOID CASES AND DEATHS AT HAVANA, CUBA, JUNE AND JULY

| | Cases | | Deaths | |
|---|---|---|---|---|
| June 1-10 | 4 | | 1 | |
| June 11-20 | 20 | | 4 | |
| June 21-30 | 173 | 197 | 18 | 23 |
| July 1-10 | 204 | | 39 | |
| July 11-20 | 100 | | 20 | |
| July 21-30 | 89 | | 17 | |
| | | 393* | | 76 |
| June and July | | 590 | | 99 |

* Of the 393 cases in July, 93 are stated to have been brought in from the interior of the state.

On Aug. 20, in response to an inquiry from *Engineering News-Record*, Miller A. Smith, consulting engineer, Havana, wrote as follows:

"There is probably no question that the epidemic of typhoid in Havana is due to the fact that the greater part of the water supply of the city, which was originally from springs in the valley of the Almendares River, is now, owing to the greatly increased demand, principally drawn from the Almendares River itself, which is unquestionably contaminated.

"Typhoid is practically always present in Havana. It has been worse than usual during the early summer, but is now diminishing."

## Seattle Billed $683,097 for Skagit Tunnel Extras

### Claim Put in After Plant Is Accepted by City Covers 31 Items—Time Extension Also Asked

The two-mile tunnel of the Gorge Creek hydro-electric plant on the Skagit project, built for the city of Seattle by R. C. Storrie & Co., contractors, has been completed and on Aug. 9 was accepted by the city's Board of Public Works. On Aug. 11 the contractors filed with the city a claim for $683,097 over and above the $2,203,865 contract price agreed upon for the job, this claim including 31 items of work performed and materials furnished which are said not to have been specified in the contract.

The contractors also served notice of delays resulting from causes over which they had no control, and for which a 10½ month time extension is claimed. The contract included a penalty of $500 for each day of delay after Oct. 1, 1923. The Seattle Board of Public Works some time ago admitted liability for some of the delays and granted a 100 day extension. Of the total contract price all but $300,000 has already been paid. A note on recent action of the Seattle city council with reference to the Skagit project appeared in *Engineering News-Record*, July 24, p. 155.

Some of the principal items in the contractors' claim for extras are as follows:

| | |
|---|---|
| Excavation in excess of contract figures | $121,505 |
| Additional concrete in tunnel lining | 197,534 |
| Fine sand furnished, not specified | 17,114 |
| Change in method of concreting | 36,996 |
| Additional cement | 72,005 |
| Drilling additional holes for grouting | 7,144 |
| Grouting main tunnel (city's proportion) | 18,835 |
| Increase in size of temporary intake | 8,901 |
| Miscellaneous items previously reported | 170,423 |

The delays listed include lack of power from the ctiy's plant, transportation interruptions, earth slides, forest fires, floods, and "delay caused by the city commandeering all sand and gravel for its concreting at the power plant, thereby necessitating suspension of concreting by the contractors."

A great deal of publicity about Skagit matters in the daily press of Seattle, much of it of a partisan nature, has resulted from the activity of taxpayers hostile to municipal ownership and has delayed and complicated settlement of the contract work. However, to quote one city official in close touch with the situation, "when publicity seekers have secured all the publicity obtainable from the controversy, differences with the contractor will be amicably settled."

## Dr. Mead on Reclamation Project Needs

### Consolidation of Farming Operations And Careful Colonization Plan Among Needs

One of the needs on certain of the reclamation projects, noted by Dr. Elwood Mead, the Commissioner of Reclamation, on his recent western trip, is the consolidation of farming operations. On some of the projects the raisins have been picked from the pie. There are canals and laterals enough to irrigate the entire area, but the farms are scattered and much water is required for the unoccupied areas. Even a worse situation is created when the project is not properly delimited. There is the utmost need, he points out, for confining projects to an area which can be served by the available water supply. Since his trip Dr. Mead is more convinced than ever that there should be a legal determination wherever there is question as to water rights. These disputes usually become more aggravated as time passes. Another reason for prompt action in such instances is the length of time required for the courts to pass finally on such questions.

Dr. Mead found that the new settlers on the Milk River project have reached the point where they should put in siphons to insure water for the future. Other urgent needs which came to his attention include the limiting of the area of the Okanogan project, the completion of the Sun River storage and of the storage on the North Platte.

#### Typical Factors Outlined

A number of typical factors in the development of present and future reclamation projects are outlined in a special report upon the trip. The necessity of a carefully planned policy for the colonization of future irrigation projects is emphasized. Six proposed projects are now under study, and on each an economic survey has been organized by G. C. Kreutzer, director of the Division of Farm Economics; the co-operation of state agricultural colleges has been enlisted. By studies of soil and farm economics the value of the irrigation water will be determined, and the cost of converting the raw land into improved farms will be estimated. The conclusions so obtained will later be submitted to local committees of bankers, farmers and business men to pass upon the feasibility of the project and the cost and methods of development. Dr. Mead says:

"The acre cost of water rights under past public notices has varied from $14 to $118, with only three over $100. New projects under consideration vary from $97 to $157. There is little prospect that any irrigation works built hereafter by the government will cost less than $100 an acre, and one now authorized may cost $200 an acre. This is for the canals and reservoirs only. In order to use the water and to create homes, land must be settled, houses, farms and fences built; these with farm equipment will add close to $100 per acre to the cost of the farm."

He recommends that land be sold to the settlers on business-like terms, with interest at 5 per cent and yearly principal payments of 1 per cent, which would pay for the farm in 34½ years and eliminate the risk of mortgage foreclosure. It is urged that farms be valued according to location, quality of soil and ease of irrigation before fixing the price to be paid by the settler. Settlers should be required to have not less than $1,500 capital. Money advances to aid the settler in building his house and making similar permanent improvements are recommended. No specific proposal is made, but it is urged that "money advanced for farm improvements should pay 5 per cent interest and the period of re-payment should vary from 3 to 20 years. A 20-year loan on permanent improvements like a house is safe, and yearly payments of 3 per cent on the principal, making a total of 8 per cent, will pay off the debt in 20 years."

#### Present Methods of Settlement

Present methods of settlement and their use by settlers for speculative purposes are illustrated in the report in the following:

"I have just inspected an area on a federal irrigation project where the settlers for 80 farms of un-entered public land were chosen by a lottery. It is evident that the majority of the settlers had no conception of the responsibilities that they were assuming. They thought the government was giving them something. On many of the farms they erected the same kind of a shack the nominal homesteader used to erect. This was a 10x12 tar-paper structure without a floor. Without money and experience they could go no farther. Many of them did not know how to try, and what they did was to look for someone who would rent their holding. They found what they sought in a group of Russians, who are the tenants on nearly all of the 65 farms now rented. Instead of an American soldier settlement we have created an alien colony. The reclamation fund is not being reimbursed. All the desirable social and economic purposes of the law are being lost and the Bureau has a problem that never would have been created under a properly-thought-out plan of settlement."

Another phase of the reclamation problem, illustrating the unwillingness of project farmers to recognize the priority of their obligations to the government is given in the following paragraph:

"We are next spring to announce project costs on an area that was settled and has been cultivated by dry farming methods. The people living on this land urged the government to build a canal and agreed to pay the cost, but now that he time has come to assume this obligation they state that the cost is more than they can afford to pay. They say that no payment should be required for the first five years because the settlers are so heavily in debt that they must first pay off their mortgages and get rid of high interest rates before they can consider paying the government, and they will use every effort possible to have the government forego payment in order that their financial corpse may be resurrected."

## Broad Street Subway Started

Work was started on Aug. 25 on the Broad St. subway in Philadelphia. The start of work was made with official ceremonies at Broad St. and Lehigh Avenue, which point is about at the middle of the section covered by Contract 105B. This contract, together with Contract 105A, is held by Keystone State Construction Co. of Philadelphia. The two contracts cover the subway from Stiles St. to Clearfield St. (See *Engineering News-Record*, July 31, p. 194.)

The start of work was made by the removal of a portion of the pavement of Broad St. The work is to be done by cut and cover methods to secure a minimum of interference with street traffic. At the location near Lehigh Avenue, shaft openings will be constructed, and loading bins and construction apparatus will be erected upon falsework spanning the street.

## Columbia Grants Engineering Degrees After Five Years

Modifications adopted by the school of mines, engineering and chemistry of Columbia University, New York, make it possible for the student to obtain his degree in five years instead of six, according to an announcement by Dean George P. Pegram. Pre-engineering training may be completed in two years instead of three. The changes, Dean Pegram has explained, add flexibility to the admission requirements, but do not alter the engineering course.

Heretofore, students have been admitted into the school of mines, engineering and chemistry after satisfying the requirements of three years of undergraduate collegiate study. Under the professional option usual in universities, the students receive the A.B. degree upon the completion of their first year's work in a professional school, that is, at the end of the fourth year, and the engineering degree two years later. Columbia authorities have approved a modification of the admission requirements under which a student entering Columbia College with credits in elementary physics, chemistry and advanced mathematics, may on completion of a prescribed course, covering only two years and a summer session, enter the engineering school.

Students taking the shortened pre-engineering course will not be eligible for the A.B. degree under the professional option, and the faculty has therefore voted to award the B.S. degree to these students at the end of their fourth year.

"These changes in the direction of greater flexibility in the admission requirements are not accompanied by any changes whatever in the three-year professional engineering course in the school of mines, engineering and chemistry," Dean Pegram makes plain. "They simply provide as an alternative to the present plan of an A.B. degree in four years and an engineering degree in six, and the student in more strictly prescribed courses may receive the B.S. degree from the engineering school in four years, the higher engineering degree in five years."

## Conflict Over Power Site in Owens River Gorge

*Washington Correspondence*

The Southern Sierras Power Co. has filed an amended application for license covering the project in Owens River Gorge for which the city of Los Angeles also is claiming rights.

The lands involved in this power site have been the subject of legislative action. In 1906 Congress authorized the sale to Los Angeles of certain of these lands in connection with its aqueduct project. On this authority the city bought up large areas in the river valley. Some contend that these purchases exceeded any area contemplated by the act of Congress. The General Land Office at one time questioned the validity of the transaction, but the Secretary of the Interior confirmed the sale of these lands to the city. A patent finally was issued in 1913 but it contained certain reservations as to the outstanding water rights. An act approved June 5, 1920, extended the scope of the original grant but contained a number of conditions which invite controversy.

The Southern Sierras Co. contends that these reservations and conditions were inserted in the law to protect its established rights and those of its predecessors in this section of the Owens River. On this assumption the Southern Sierras Co. applied for the license which is in direct conflict with the Los Angeles program. The point now has been reached where the Federal Power Commission must make a decision in the matter. While final action has not been taken, it is understood that the study indicates that it is not within the jurisdiction of the commission to question the validity of the patent granted by the Secretary of the Interior. For that reason the indications are that it will be necessary to deny the application of the Southern Sierras Co. which apparently leaves the courts as the only recourse to which the power company can appeal.

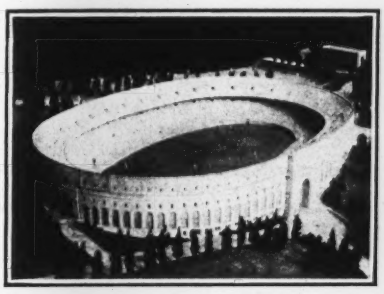
## Approval of Proposed Railway to The "Lost Provinces" Asked

A commission appointed by the governor of North Carolina has applied to the Interstate Commerce Commission for authority to construct the Appalachian and Western North Carolina R.R. to form a main trunk line across the state of North Carolina, east and west, from the coal fields to the seaboard and ports, to connect with existing lines operating within North Carolina and Tennessee. The railway is to extend from Taylorsville, N. C., and Mountain City, Tenn., or between Taylorsville and Butler, Tenn., or between Doughton, N. C., and Mountain City, Tenn. The total length of main line track is to be approximately 125 miles.

Funds for the construction of the railroad, the total amount not to exceed $10,000,000, are to be advanced by the state of North Carolina. Details of the proposal to build this railway were given in *Engineering News-Record*, Nov. 29, 1923, p. 878.

## Construction of University of Pittsburgh Stadium Begins

Contract was recently let to the John F. Casey Co. of Pittsburgh for the general grading work on the construction of a stadium for the University of Pittsburgh. The stadium will be of double deck bowl type, designed for a total seating capacity of 90,000. Present plans contemplate the building of the entire lower deck and five sections



ARCHITECT'S SKETCH OF UNIVERSITY OF PITTSBURGH STADIUM

of the upper deck at this time with a capacity of 70,000 seats. The stadium will be 790 ft. long, 615 ft. wide on the main axes. It will accommodate football, baseball, basket ball, track and other indoor athletic activities. It will be almost entirely of concrete and steel construction.

Plans for the foundations and superstructure will probably be completed in about six weeks. W. S. Hindman is chief engineer of the stadium committee, J. Hammond Smith consulting engineer, and Stone & Webster, Inc., supervising engineers.

## Traffic Safety Body Meets

Initial plans to aid communities in laying out and following up safety programs in order to check highway and street accidents were outlined and discussed at a meeting Aug. 11 of the committee on public relations of the Conference on Street and Highway Safety. The committee is one of a group recently organized under the auspices of the Department of Commerce. This particular committee is headed by George M. Graham, vice-president of the Chandler Motor Co. Discussion at the conference brought out the fact that many communities are bewildered as to the best method of meeting the accident problem. Therefore, decision was made that the committee divide its studies into two phases, one dealing with official relations and one with co-operating non-official bodies. It was decided that methods of procedure should be outlined wherein recommendations of the seven other committees in the conference could be put into practice.

Among the miscellaneous topics of discussion were interstate standards for automobile headlights, standards for uniform rear signal lights, uniform hand signals and uniform traffic regulation. Some speakers emphasized the need for eliminating any but official direction or warning signs. The next meeting is to be held Sept. 15.

## Concessions Granted for Railroad in Northern Mexico

The Mexican Government has granted a railroad concession to the Tampico & Northern Railroad Co. (Compania del Ferrocarril del Tampico y Norte S. A.) for the construction of a railroad from Tampico, in a northerly direction along the coast, to San Fernando and thence to Camargo on the Rio Grande River, opposite Rio Grande City, Texas, and a branch line from San Fernando to Matamoros, Mexico, opposite Brownsville, Tex. The company is made up in part of business men of San Antonio, Tex., who plan to continue the line from Camargo 230 miles across Texas to San Antonio. South from Tampico the Corona R.R. is in operation for 40 miles to Higo. With the closure of the gap of 140 miles between Higo and Ixmiquilpan and the 91 miles from Ixmiquilpan to Mexico City, part of which is built and part is now under construction, there will be formed a new line from the United States to Mexico City. The distance from San Antonio will be about 844 miles as compared with 957 miles by the existing route.

The same group of men also plans the construction of a line 22 miles long from Sam Fordyce, Tex., to Rio Grande City, Tex. Right-of-way for this line has been acquired and some of the material is on the ground.

## St. Louis Plans $50,000,000 Bond Issue for Subway

Recommendation that an ordinance be prepared authorizing the flotation of a $50,000,000 bond issue by the city of St. Louis to construct a subway in the downtown section will be made by C. E. Smith, consulting engineer of that city, at the reconvening of the board of aldermen in late September, according to press reports. It is probable that a special committee of the board of aldermen will, before the ordinance is drawn, make a trip to Boston, Philadelphia, New York and other cities to study rapid transit facilities. The present plan is that this committee, accompanied by Mr. Smith and E. R. Kinsey, president of the board of public service, will leave Sept. 1, to be gone for about two weeks.

Mr. Smith has long advocated rapid transit for St. Louis. Last June he presented tentative plans to the aldermanic transportation committee which resulted in preparations for the trip to be taken in September. The plan has the hearty endorsement of Mayor Kiel.

Tentative plans for the subway include construction of a subway loop from Eighteenth St. down to Market St. over Third and up Washington Avenue. A third loop would serve crosstown traffic running under Broadway. Another feature of the plan includes a group for railroads serving the suburban communities beginning at Eighteenth St. and running to a downtown station at Eighth and Market St., and another unit provides for an elevated system running from Eighteenth St. West.

## Baltimore Plans Reorganization of Engineering Bureaus

A plan for the complete reorganization of the engineering and construction departments of Baltimore has been submitted by the commission on efficiency and economy appointed by Mayor Howard W. Jackson. The plan has the approval of the mayor and if the city council passes the necessary ordinance it will be submitted to popular vote in November.

Under the proposed plan a department of public works would be created, under which there would be 11 bureaus: water, highways, sewers, harbor, mechanical-electrical, buildings, surveys and drafting, standards, street cleaning, transportation, and stores.

The water engineer would head the water bureau and displace the present water board; the highway engineer would head the highways department; the harbor bureau, under the harbor engineer, would take over the work of the harbor board; an engineer would have charge of the mechanical-electrical bureau and the present electrical commission would be abolished; the inspector of buildings would head the bureau of buildings; the bureau of surveys and drafting would include the present topographical survey and the city surveyor.

## Road Building Record Broken in Illinois

During the week ending July 31 all previous records attained in the construction of highways were broken by the Illinois Highway Department. During that week a total of 60.79 miles of pavement was constructed exceeding by 3.09 miles the record established in 1923. Officials of the Division of Highways are optimistic over the possibility of furthering that mark as the present season advances. Noteworthy performance was attained by the W. C. Meneely Co. working on Route 2 between Decatur and Cairo. This company laid 2,671 ft. of standard 18-ft. concrete pavement in one day with one mixer. The same company during the construction season of 1923 laid 2,017 ft. of pavement under similar circumstances. During the week ending July 31, the same paving company completed 10,405 ft. of standard 18-ft. pavement.

The paving completed so far this year totals 561.02 miles or approximately 65 miles more than the amount completed up to the same date last year. During 1923 Illinois completed 1,085 miles of paving and there is now little doubt in the minds of the highway officials but that the state will break this record before the end of the present season.

## Work Under Way on Fort Snelling-Mendota Highway Bridge

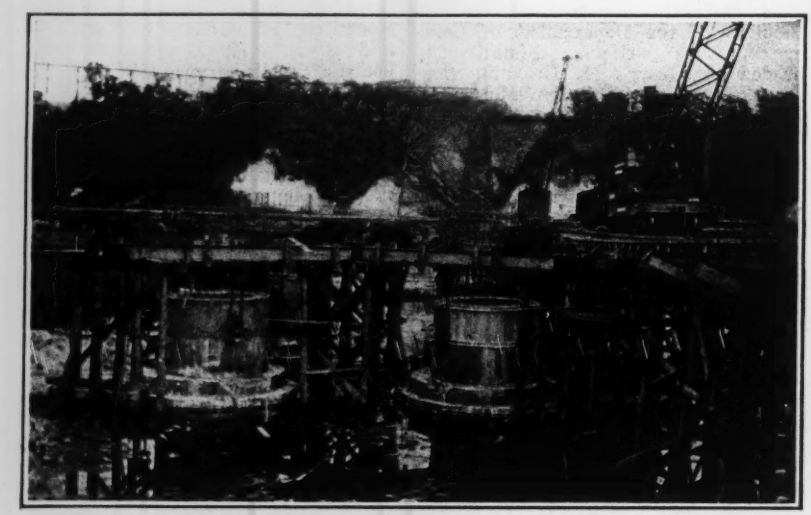
Work is well under way on the construction of the twelve-span reinforced concrete highway bridge across the Minnesota River connecting Fort Snelling with Mendota. The accompanying photograph shows the caissons used for pier 16 and the lower 10 ft. of the caisson shells completed and partly lowered. The shoes are submerged about 11 ft. The caissons are to be sunk about 70 ft. The photograph also shows the beginning of the falsework construction for the east arch and forms for the east abutment.

The caissons here shown are 14 ft. in diameter with cutting edges 22 ft. in diameter. They will be temporarily suspended and lowered until they reach sufficiently firm material to support their own weight.

Superstructure of the bridge is to be ribbed-arch construction, two ribs to each span. The deck will be supported from ribs on columns and consists of flat slab design with depressions over the columns.

The contract for the construction of the bridge is held by the Koss Construction Co. Walter H. Wheeler and the C. A. P. Turner Co. are the associated engineers.

More detailed information on the bridge will be found in *Engineering News-Record*, May 22, 1924, p. 911



SINKING FIRST CAISSONS FOR FORT-SNELLING-MENDOTA BRIDGE

## Lease of C., C. & O. Ry. Calls for New Construction

Lease of the Carolina, Clinchfield & Ohio Ry. on the basis of the terms set down by the Interstate Commerce Commission has been accepted by the Atlantic Coast Line R.R. and its subsidiary, the Louisville & Nashville R.R. The Interstate Commerce Commission order requires that the C. C. & O. be continued as a separate entity; that existing routes and channels of trade in connection with the C. C. & O. be maintained; and that within a period of twelve months the Louisville & Nashville R.R. shall start the construction of two branch lines that will connect with the C. C. & O. Ry.

No definite announcement of the route of these connections has been made, but it is considered probable that one will be by an extension of the Lexington and Eastern branch of the L. & N. from McRoberts, Ky., to connect with the C. C. & O. near Elkhorn City, Ky., the other may be by a connection from the Harlan County branch somewhere near its eastern terminal, either by an entirely new line or by a combination of existing lines.

## Bi-State Port Authority Proposed

Governor Silzer, of New Jersey, has suggested the creation of a port authority similar to the one set up by the states of New York and New Jersey for the port of New York, to be organized by the states of New Jersey and Pennsylvania for the port of Philadelphia. He would have this body so constituted that it could undertake the financing and construction of a second bridge across the Delaware, between Philadelphia and Camden. His suggestion for a second bridge is based upon the survey prepared by the engineers of the Delaware River Bridge Joint Commission, which shows that when the bridge now under construction is opened in 1926, the cross-river traffic will have so increased that it will exceed the peak capacity of the new bridge. George S. Webster, a member of the board of engineers of the Joint Commission, has suggested that the second bridge be built at Allegheny Ave. at an estimated expenditure of $20,000,000.

## Los Angeles to Build Incinerator

Bids for a central incinerator of 200 tons' daily capacity and possibly for some incinerators in outlying districts will be invited by Los Angeles, Calif., as soon as sites for the plants have been obtained. This action has been made necessary by (1) the rapid increase in the population of the city pouring into vacant areas heretofore used for open-air burning of refuse and (2) county legislation prohibiting garbage of the city being taken outside the city limits. On June 6 the city voted to provide incinerators to burn rubbish, market refuse and a part of the street sweepings. At the proposed 200-ton central plant would be burned a mixture of about half combustible rubbish and half market refuse, the latter including wastes from vegetable and fruit industries.

## Civil Service Examination

UNITED STATES

*For the following civil service examination apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission.*

**Assistant Structural Engineer**—Vacancy in the supervising architect's office, Treasury Department, entrance salary $2,400 with possibility of advancement to $4,000, the duties of the position requiring five years of engineering experience, including steel and reinforced concrete designing, or three years of such experience and a degree in civil engineering from a technical school of recognized standing. The work is on the engineering problems involved in building construction.

The examination will be given throughout the country on Sept. 17.

# Engineering Societies

## Calendar

**Annual Meetings**

AMERICAN SOCIETY OF SANITARY ENGINEERING, New York; Annual Convention, Philadelphia, Pa., Sept. 9-12, 1924.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Meeting, Rochester, N. Y.; Sept. 30 to Oct. 3.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburgh, Fla.; Annual Convention, Boston, Mass., Sept. 29-Oct. 3, 1924.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Detroit, Oct. 23-25, 1924.

**The Western Society of Engineers** on Aug. 15 started the first of its annual summer outings in an all-day trip to Michigan City. The new manufacturing plant of the Sullivan Machinery Co. concerning features of which the society plans an early lengthy discussion, was the objective of the trip. Points of interest in the factory were outlined by S. T. Nelson, superintendent.

**The Western Association of State Highway Officials** at its annual meeting July 11 and 12 at Mammoth Hotel, Yellowstone Park, elected the following officers: President, G. W. Borden; Nevada state highway engineer; vice-president, Roy Klein, Oregon state highway engineer; secretary, Z. E. Sevison, state highway engineer of Wyoming. Topics covered in the seven papers read and discussed were gravel roads, surety bonds from the engineers' and company standpoints, forest highway standards, national park roads and construction, and timber bridges on federal aid projects. Resolutions passed urged Congress to make early appropriations for national park roads under the $7,500,000 three-year authorization, and declared the association in favor of a two-year program of $100,000,000 for federal highways and $10,000,000 a year on forest highways.

# Personal Notes

J. M. BIXBY, Poughkeepsie, N. Y., has been appointed division engineer of Division 1 of the New York State Highway Department. His headquarters are at Poughkeepsie. He succeeds James H. Sturdevant, who resigned several months ago.

MORRIS BIEN, of whom a notice in these columns on July 24 stated that he had left the U. S. Bureau of Reclamation and that he would conduct a consulting practice in Washington, D. C., writes that the practice in which he is now engaged is not consulting engineering but a general legal practice, which will utilize, however, his engineering education and the experience gained in his many years of government service.

H. H. RODE, representative of Gustav Lindenthal of New York, who in July was retained by the new board of commissioners of Multnomah County, Oregone, to supervise redesign of three bridges at Portland, Ore., has arrived in Portland and will be in direct charge of the construction of these bridges, for Multnomah County and the city of Portland. The three bridges (as noted in our issue of July 17, p. 118) are the Burnside bridge, which is to be completed with modifications of the original design, the Ross Island bridge, to be built as a steel span instead of as a concrete arch bridge, and the Sellwood bridge, which is to be redesigned architecturally and to have new steel instead of old steel from the Burnside bridge. All three are Willamette River bridges.

U. F. TURPIN, formerly assistant engineer with W. E. Buell & Co., consulting engineers, Sioux City, Iowa, has accepted a position as office engineer with Consoer, Older & Quinlan, Inc., consulting engineers, 140 S. Dearborn St., Chicago, Ill.

HARRY N. JENKS has been appointed superintendent of the new pumping station and filtration works of Sacramento, Calif., in charge of their operation. The filtration division is a branch of the engineering department of the city. Mr. Jenks has been engaged on this project both on design, and construction, since 1919, except during 1922 when he was with the Sanitary District of Chicago. Other appointments made by the city engineer include that of CARL M. HOSKINSON as chief engineer of the pumping station, and of RALPH A. STEVENSON as chemist and bacteriologist of the filter plant. The complete project cost $2,700,000 and was designed by Charles Gilman Hyde, consulting engineer, assisted by a staff of engineers appointed by the city. C. G. Gillespie and George J. Calder served as resident engineers during the periods of design and construction. The initial operation of the new works began Jan. 1.

R. KEITH COMPTON, for several years chairman and consulting engineer of the paving commission of Baltimore, Md., has been appointed director of public works for the city of Richmond, Va., effective Sept. 15. He will succeed in this position ALLEN J. SAVILLE, who recently resigned to engage in private practice in Richmond. Mr. Compton, who is a graduate of Maryland State College with the degree of civil engineer, has been in the service of the city of Baltimore most of the time since 1890, first as assistant engineer on sewer construction and later assistant city engineer in charge of highway maintenance. From the latter, in 1911, he became chief of the paving commission as noted above. During the World War he served as major of engineers, in charge of construction of roads and buildings at Camp Meade, Md., in general charge of roads, docks, water supply and sewerage in the Curtis Bay Ordnance Depot and of the Roads Quarantine Station, both at Baltimore, and as executive officer at the acid plant at Little Rock, Ark. In 1919, with the rank of lieutenant-colonel, he left the army and returned to the chairmanship of the paving commission of the city of Baltimore.

FRED A. NOETZLI, consulting engineer, Los Angeles, Calif., has been appointed consulting engineer for the investigation of the proposed enlargement of the multiple arch dam built in 1917 by Salt Lake City, Utah. The dam was originally designed by John S. Eastwood. The structure was built to a height of 100 ft. above stream bed, and it is now proposed to raise the dam to the ultimate height of 140 ft.

T. H. Judd, for the past four years resident engineer on the city of Seattle Skagit River power development, has joined the engineering forces of the state supervisor of hydraulics at Olympia, Wash.

C. F. PRICE, city manager of San Mateo, Calif., has resigned, effective at once. Mr. Price was formerly connected with the California State Highway Commission.

H. B. HOLLISTER, civil engineer, formerly with the Detroit Edison Co., has joined the organization of the Spencer, White & Prentis, Inc., New York City, as estimator.

# Obituary

JAMES H. CORBETT, president of The James H. Corbett & Sons Co., general contractors, Pittsburgh, Pa., died August 11, at his home in Hammond, La.

JAMES E. MARTIN, a pioneer bridge builder of Sullivan County, Ind., died at his home at Sullivan, Ind., recently of diseases incident to old age.

CLINTON COWEN, civil engineer, Cincinnati, Ohio, who from 1901 to 1915 was county surveyor of Hamilton County, Ohio, and from 1915 to 1919, state highway commissioner of Ohio, died August 21, at Manitou Island, Canada, after a brief illness. Mr. Cowen was in his 60th year. He had been in Canada about a month on a hunting and fishing trip.

# From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

## Road Show Applications Close Oct. 15

**Manager Charles M. Upham Announces Detailed Procedure to Be Followed By Exhibitors of Equipment**

Applications for exhibit space at the 16th National Good Roads Show, to be held at the Coliseum, Chicago, Jan. 5-9, 1925, inclusive, simultaneously with the annual convention of the American Road Builders' Association, will close Oct. 15, according to an announcement just made by Charles M. Upham, convention and show manager. Exhibitors at the show must be members of the Highway Industries Exhibitors' Association; manufacturers desiring to join this organization should address C. R. Ege, treasurer, 1,200 Wrigley Building, Chicago.

Additional space will be available for the forthcoming show. A new extension has been added to the north end of the Coliseum, which will be utilized in addition to the Coliseum proper, the Annex and the Greer building. The show will open at 8 p.m., Monday, Jan. 5 and will continue from 9 a.m. until 9 p.m. daily, until Friday, Jan. 9, when the show will close at 4 p.m.

Exhibits will be received for storage one week before the opening of the show. Manufacturers are urged to ship early to reduce congestion in receipt of machinery and materials and to save cost of overtime in handling. The following scale of prices for exhibit space is announced.

| | Per Sq. Ft. |
|---|---|
| Coliseum and New Coliseum | |
| Wall space | $1.20 |
| Space on three aisles | 1.65 |
| Other spaces | 1.40 |
| Annex | |
| Wall space | 1.40 |
| Center space | 1.50 |
| Greer Building | |
| Space | 1.10 |
| Ball Room | |
| Space | 1.10 |
| Balcony | |
| Space | 1.00 |

The Ball Room will be available for the erection of exhibits after 8 a.m., Jan. 2, and all exhibits in this section must be completely erected by Saturday night, Jan. 3. The Greer building will be available after 8 a.m., Jan. 1, and exhibits there must be erected by the night of Jan. 3. The Coliseum and its new addition will be available after midnight, Jan. 1, and exhibits must be in place by 6 p.m., Monday, Jan. 5.

## Equipment Distributors to Meet

Jan. 2, 3 and 5, 1925, are the days which have been selected for the annual meeting of the Associated Equipment Distributors at the Milwaukee Athletic Club, Milwaukee. The meeting, coming just before the annual Good Roads Show and convention of the American Road Builders' Association at Chicago, will concern itself with problems of equipment design, maintenance and marketing. On Jan. 5 there will be a joint discussion of construction equipment problems by representatives of leading manufacturers and distributors. More than 200 manufacturers, it is stated, have signified their intention of sending representatives to the meeting of the equipment distributors.

The arrangements for the meeting are in charge of the executive committee headed by K. B. Noble, of Hartford, Conn., president, and M. R. Hunter, Milwaukee, secretary.

## *Construction Equipment—Past and Present*

Supplementing the historical notes on the origin and development of the road grader, published in *Engineering News-Record* of July 10, p. 80, and July 17, p. 120, the following statement regarding an improvement in design not noted in the articles referred to has been received from the Stockland Road Machinery Co., Minneapolis:

"We feel that we have some claim to having developed a distinctive feature in connection with the present-day road grader. On all road machines except the Stockland the blade and circle are lifted entirely by means of two large hand-wheels which work on worms. This is a laborious and time-consuming method of raising the blade, as it is necessary on large machines to turn the hand-wheels twenty or thirty times before the blade is high enough from the ground to clear an obstruction. It is also necessary to stop the grader and tractor before reaching the obstruction, raise the blade, stop again and readjust the cut of the blade.

"The Stockland company developed the Quicklift, which is simple, efficient, and an exclusive patent. It is worked by means of two coil springs operating on an eccentric and counteracting the weight of the blade and circle. When lowered the Quicklift lever raises both the front and rear of the blade assembly. The raising of the lever restores the blade to its exact former adjustment. This feature is of great value in town or city work where it is necessary to pass numerous obstructions in the way of driveways, culverts, etc. It is possible to do about 20 per cent more actual grading on a similar piece of road in a given time with the Quicklift device than without it."

## *Business Notes*

RAYMOND CONCRETE PILE CO., New York, has opened an office at 425 West Building, Houston, Texas, in charge of George F. Weismann, district manager. A. C. Everham, district manager of the Kansas City office, in addition to his present duties, will assist Mr. Weismann in handling the new territory.

ASPHALT ASSOCIATION, New York, has appointed Vibert L. Ostrander manager of its eastern branch with offices at 25 North Pearl St., Albany, N. Y. Mr. Ostrander was formerly first deputy commissioner of highways of the State of New York.

BULL DOG FLOOR CLIP CO., Winterset, Ia., was notified, July 29, by the U. S. Patent Office of the reissue of the patent for its floor clip. The issuance of this patent, the company states, ends a two-year litigation with Elmer K. Cole, of the Munson Manufacturing Co., as to the patent rights involved. The original Bull Dog floor clip was invented by C. W. Prickett in 1921; it is a device used in connection with the laying of wood floors on a concrete base.

C. R. BURT recently resigned as president of the Austin Machinery Corporation, Muskegon, Mich. (formerly Toledo, Ohio) to become general manager of the Pratt & Whitney Co., Hartford, Conn., manufacturer of machine tools, small tools and gages.

## *Equipment and Materials*

### New Two-Cycle Diesel Engine Has Double-Acting Cylinder

A new design of two-cycle, double-acting Diesel engine has just been announced by the Worthington Pump & Machinery Corporation, New York. The new engine, it is claimed, combines a fuel economy comparable with that of the best existing types of Diesel engine, with dimensions, weight and construction cost per horsepower approaching those of reciprocating steam machinery. Another feature is the fact that the horsepower per cylinder can, from all indications, be carried to a far higher value than any yet attained in Diesel engines. The first unit built in the Buffalo plant of the Worthington corporation is rated at 600 to 800 hp. for a single-cylinder unit at speeds of 90 to 120 r.p.m. The leading collaborators in the research leading to the design of the present engine were O. E. Jorgenson, for the past five years a member of the Worthington technical staff, and Dr. C. E. Lucke, professor of mechanical engineering, Columbia University, New York.

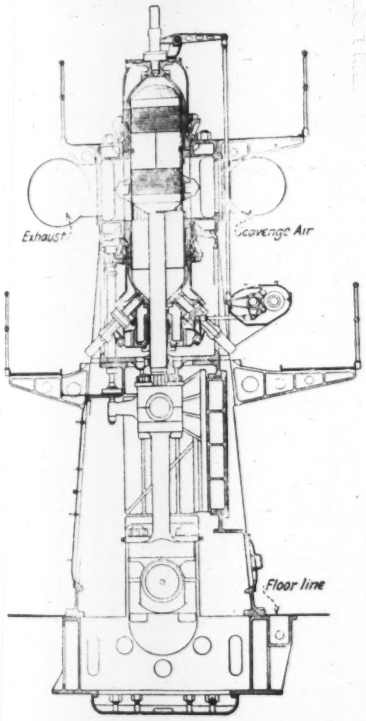
EVERY STROKE A POWER STROKE

The basic principle underlying the Worthington engine may be briefly stated as follows: In the four-cycle Diesel engine one stroke in four is a power-stroke; in the two-cycle engine one stroke in two; in the new engine every stroke is a power stroke. Its working cycle, therefore, is virtually the same as that of a reciprocating steam engine. Heat stresses in the cylinder of a double-acting engine have hitherto interfered with its successful application. The feature of the Worth-

ington design lies in the manner in which the problems of expansion and of heat removal are treated.

The cylinder of the new engine might be described as composed of two single-acting cylinders, opposed end for end and working in opposite directions their respective pistons flanged to the same rod, the scavenging and exhaust ports, cooling water circulation and expansion provisions of the two being virtually independent of each other. The valve gear presents no particular novelty in design. There are three fuel spray valves, one on top of the upper end of the cylinder, and two in the bottom head on opposite sides of the piston-rod, entering at an angle. The two lower valves are arranged so as to give a uniform and symmetrical distribution of the charge around the piston rod.

The reversing mechanism, as a point of interest, is second only to the unique cylinder design. Each of the three valves has its own cam, all three geared to the same shaft. The cams are symmetrical, and all that is necessary to reverse the running direction is to shift all three cams simultaneously through




34 deg. on the shaft. This is accomplished by a worm shaft, which in turn is actuated by an oil-operated hydraulic mechanism controlled by a four-way cock, this in turn being operated by a single lever on the maneuvring platform.

The engine is started and stopped by a single lever, which as it is moved forward successively opens the air starting valves, then the fuel supply valves, simultaneously closing the air starting valves; the lever being then capable of setting, by a ratchet and pawl, at any desired fuel supply. To stop, all that is necessary is to throw this lever back to the stop position. The starting and stopping lever and the reversing lever, though independent of each other in all other respects, are interlocked so that the engine must be brought to a full stop before reversing.

## Loader Used to Place Earth for Curing Concrete Roads

Machine-handling methods for placing earth on newly constructed concrete roads as part of the curing process were recently applied by Superintendent Crane, of the R. F. Conway Co., Chicago. After the earth shoulders on

either side of the finished concrete slab had been rooted up with a plow, a Barber-Greene self-feeding bucket loader, operating on crawler traction, was driven along the route, picked up the loosened earth and distributed it on the freshly cast slab by means of a swivel spout, as shown in the accompanying photograph. Shovelers then spread the earth over the concrete surface. This method is said to have speeded up the work and cut down on the number of men ordinarily required for this operation.

## Screw Type Hoist for Motor Truck Dump Body

Utilizing the principle of the screw jack, a new hoist for motor truck dump bodies has been developed by the Van Dorn Iron Works, Cleveland. Power developed by the truck engine is transmitted to lift arms by gears operating a screw jack in a plunger, which, in turn, actuates cables attached to sheave wheels. A point on each sheave wheel

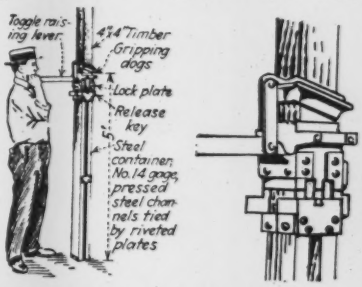
is pivoted to the lift arms which raise the body of the truck. Inequalities of pressure applied to the cables are automatically taken up by a ball-bearing equalizing yoke.

All moving parts of the screw jack are incased and run in oil. With the screw hoist, the truck body can be raised, lowered and locked at any point up to 45 deg., the automatic stopping point. The body cannot lower by itself, thereby causing accident. It may be lowered only by the application of power from the motor truck. In capacity, the hoist can handle up to 7½ tons.

## Adjustable Shore Has Locking Head and Release Feature

Adjustability within a wide range of heights and quick release through a special form of locking head are features of a new form of vertical shore for concrete forms consisting of a steel container 5 ft. long, into which telescopes an ordinary 4x4-in. timber, which is held in position by a pair of gripping dogs. The device, known as the O.D.G. adjustable combination shore, has just been placed on the market by the O.D.G. Co., Owensboro, Ky.

The container element consists of two steel channels 5 ft. long held together by rivited steel straps, a base plate and a locking head. This container is just large enough to receive a 4x4-in. timber, which may be jacked up to bear against the under side of the form to be supported by a toggle




type of raising lever equipped with a gripping collar fitting around the timber. Steel gripping dogs in the head of the container hold the timber from slipping back.

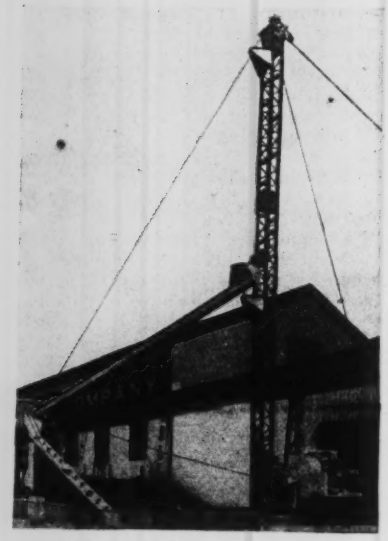
In striking forms it becomes necessary to lower the top of the shore. This is accomplished by a locking plate and a pair of notched release keys in the container head. When the locking plate is raised, the release keys are forced by the top of a hammer to slide sideways, allowing tongues in the head to interlock with grooves in the release keys. This permits the top of the shore to drop ¾ in., sufficient to release the load and allow the gripping dogs to be raised and the shore telescoped for removal.

The shore weighs 33½ lb. One of the chief advantages claimed for it is that it permits the use of ordinary 4x4-in. timber, to which, if desired, bracing may be nailed, either above or below the locking head (in the latter case through the slots in the sides of the steel container). The range of adjustment is 4 ft.

## New Concrete Chuting Handles Small Jobs

To its line of concrete chuting equipment for large projects the Ransome Concrete Machinery Co., Dunellen, N. J., has added a new product of the mast hoist type for distributing concrete on small jobs. Built in two sizes, with bucket capacities of 7 and 14 cu.ft., the new equipment, designated by the trade name of "Monkey-on-a-Stick" may be used either with a wooden or steel mast. The steel mast is furnished in 15 ft. sections up to a height of 135 ft. while the maximum height of wooden masts is 75 ft.

There are three types of plant available with the new equipment. (1) The boom chute plant (used with steel mast only) where the first chute and



half of the second are entirely supported by the mast; (2) the continuous line plant having the end of the first chute from the mast carried either by a tripod, gin pole or by a block and fall from a cable; and (3) the bin plant used on jobs where concrete is elevated by the mast but wheeled, instead of chuted, to place. A plant of the first type with a 32-ft. boom chute for the first section and a 32-ft. swivel head chute for the second section, will take care of a structure 80x80 ft., distributing all of the concrete directly to place. Larger structures are handled by supporting the end of the second chute and using additional lengths of swivel chutes.

In operation the short swinging chute between the bucket and the swivel head chute or bin is pushed out of the way by the bucket as it ascends and drops back under the bucket gate by its own weight. The gate is opened automatically by striking a stop. Concrete flows in a straight line from bucket to bin or chute. Openings every 7½ ft. on the mast take care of various elevations.

When operating the buckets on a single line a hoisting device that has a line pull of 1,700 lb. should be used with the 7 cu.ft. size and 3,000 lb. with the 14 cu.ft.. size.

## *Publications from the Construction Industry*

*Chimneys*—ALPHONS CUSTODIS CHIMNEY CONSTRUCTION CO., New York, has published a 92-p. illustrated treaties on the design and construction of tall chimneys for power plants and industrial works. While all of the structures described are built of a special perforated radial brick, they vary in detail to meet the special requirements of each installation. In general the chimneys are grouped into five classes: (1) The ordinary factory type built only to produce adequate draft; (2) the office building or hotel type usually running up through the building; (3) the institutional type for museums, memorials, etc., characterized by special architectural treatment; (4) high temperature chimneys for smelters, incinerators, etc.; (5) chimneys subjected to acid gases at chemical plants, dye works, and celluloid factories. After a detailed discussion of the features of each type, the text explains methods of determining the proper size of chimney. There is a discussion on the calculation of stresses in chimneys, with notes on wind velocities and their effects, and a consideration of the general subject of foundations. Advice regarding lightning rod protection also is included. An interesting feature of the text is a tabulation of the world's largest chimneys. Heading the list is the 585-ft. structure, 60 ft. in inside diameter at the top, built in 1918 for the Anaconda Copper Mining Co. of Anaconda, Mont. The book is intended to furnish engineers and architects data essential to their study of design and size of chimneys. The entire treatment of the subject is from the technical point of view. The text is logically arranged, clear, concise, and is supplemented by a well selected group of photographs and drawings. This publication should form part of the library of any engineer or architect who has to do with the design of structures involving the use of chimneys.

## American Cement Manufacturers to Visit England

A delegation of from twenty to twenty-five American cement manufacturers sailed from New York on Aug. 27 on the Aquitania to attend formal ceremonies in England from Sept. 3 to 11, in celebration of the One Hundredth Anniversary of the invention of portland cement. The main function of the occasion will be the unveiling of a tablet of Joseph Aspdin, the inventor of portland cement, in his home city of Leeds. This tablet was presented by the American cement manufacturers. The rest of the functions will be under the auspices of the Cement Makers Federation of Great Britain. The party includes F. W. Kelley and W. M. Kinney, president and general manager, respectively, of the Portland Cement Association.

# Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

## Two-Thirds of New York Construction Is Residential

Contracts awarded in the five boroughs of New York City during the first six months of the current year, totaled $514,489,500, a gain of 82.9 per cent over the first half of 1923, according to the New York Building Congress.

Nearly two-thirds of this total was for residential construction, the exact figure being $327,832,400.

VALUE OF CONTRACTS AWARDED

| 1924 | Value |
|---|---|
| January | $75,064,000 |
| February | 71,898,400 |
| March | 131,611,100 |
| April | 129,697,900 |
| May | 55,774,200 |
| June | 50,443,900 |
| Half-year total | $514,489,500 |
| First half 1923 | $281,047,900 |

The first half of this year reached its high point in March, with $131,611,100 in contracts let. Construction has been declining gradually since then.

The last quarter of 1923 combined with the first three months of the current year, represent a period of unusual winter construction activity for this city. It is one of the principal objects of the Building Congress to promote more Winter construction in order to relieve seasonal congestion in the Spring.

## National Board for Jurisdictional Awards Holds Short Session

The National Board for Jurisdictional Awards in the Construction Industry held the shortest session in its history when it met at Washington, D. C., on Monday, Aug. 4.

The following cases were the only ones scheduled for hearing: Re-inforced Concrete, Cement and Floor Construction. (Disputants, Iron Workers, Laborers and Lathers) and the Concrete Slab Re-inforced (precast) for Roof Tiling (Contestants, Bricklayers and Roofers.)

The first case was settled originally in a decision rendered by the Board on Mar. 11, 1920, at which time the placing of steel used for re-inforcement in re-inforced concrete, cement and floor construction was awarded to the Iron Workers.

The Associated General Contractors of America petitioned the Board to reopen the case at the meeting held in Pittsburgh, Pa., on Feb. 18, 1924. This request was granted and the rehearing scheduled for the meeting just held in Washington.

A number of general contractors appeared before the Board and gave their reasons why they wanted the re-inforcing rod question opened up. However,

inasmuch as none of the unions involved were present at the hearing, the Board, in executive session, decided that action on the matter should be deferred until the next meeting, which will be held in St. Louis, Dec. 8, 1924.

## Unit Prices Bid on Materials in Public Road Construction

An idea of unit costs in highway construction for various sections of the country may be gained from a study of the accompanying table.

These data were received during the past month by the Bureau of Public Roads, U. S. Department of Agriculture and show prices bid on materials in place, surfacing, excavation, haulage and common labor in twelve states.

Excavating labor, on a job involving 20,932 cu. yd. of earth in Georgia, cost 15c. per hr.; on a similar excavation covering 24,230 cu.yd. in Montana, the hourly rate was 50c.

On a project in Gibson Co., Tenn., 39,450 lb. of structural steel at 8c. per lb. were included in the award.

## Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 115 to 126, are the following:

Dam, Los Angeles, Calif., Los Angeles Flood Control Dist., $1,780,000.

Group of fireproof buildings, San Francisco, Calif., Bd. of Pub. Wks., to exceed $1,500,000.

Store, Milwaukee, Wis., Plankinton Arcade Co., $1,500,000.

School, Cleveland, O., University School, $1,000,000.

Plant, Cleveland, O., Cleveland Electric Illuminating Co., $1,000,000.

## Large Contracts Let During Week

Among the week's announcements of contracts awarded in Construction News, pp. 115 to 126, are the following:

Reservoir dam, Dallas, Tex., to W. E. Callahan Constr. Co., $3,093,488.

Office, Columbus, O., to J. Gill and Sons, $3,000,000.

Recitation Hall, Weston, Mass., to J. P. Keating, $1,000,000.

# *Business Briefs*

**Call money** remains at 2 per cent, Aug. 25.

**Time loans** ranges from 2 to 3½ per cent.

**Foreign exchange** (Demand):

| | Normal | This Week | Last Week | Year Ago |
|---|---|---|---|---|
| Sterling | $4.8665 | $4.49 | $4.47 7/16 | $4.55 |
| Franc | 0.193 | 0.0536½ | 0.0532½ | 0.0562½ |
| Lira | 0.193 | 0.0442 | 0.0441½ | 0.0450½ |

## Employment Shows Second Great Drop In Ten Years

The accompanying graph shows the general trend of employment in the manufacturing industries from June, 1914, to June, 1924, based on figures published by the Bureau of Labor Statistics. The monthly average for 1923 equals 100 and is used as the norm. The year 1923, a record construction year, also makes a standard for employment comparisons.

The plat shows that employment started to go above this set basic line

(*Continued on p. 36½*)

BID PRICES—DATA RECENTLY RECEIVED BY BUREAU OF PUBLIC ROADS

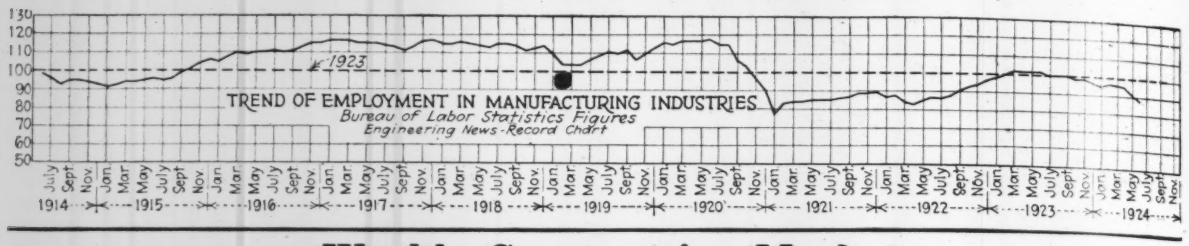
| County | Contract Let to | Gross Bid | Length, Miles | Type | Width of Surfacing, Ft. | Thickness of Surfacing, In. | Unit Prices Bid—Materials in Place: Surfacing Sq.Yds. | Surfacing Unit Price | Excavation Cu.Yds. | Excavation Unit Price | Rock Excavation Cu.Yds. | Rock Excavation Unit Price | Structural Concrete 1-2-4 Cu.Yds. | Structural Concrete 1-2-4 Unit Price | Steel Reinforcing Lbs. | Steel Reinforcing Unit Price | Average Haul, Miles | Average Hourly Wage, Common Labor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MONTANA | | | | | | | | | | | | | | | | | | |
| Sanders | Melchert Const. Co. | 53,078 | 4.04 | Cr. Gravel | 15 | 7½ | 6,111 cu.yd. | 1.95 | 24,230 | .35 | 11,062 | 1.25 | 26 | 25.00 | 1,223 | .10 | 1½ | .50 |
| NEVADA | | | | | | | | | | | | | | | | | | |
| Elko | Teaslau Bros. | 90,015 | 12.64 | Gravel | 10 | | | | | | | | 35 | 50.00 | | | 7 | .56½ |
| Elko | Simpson & Clyde | 177,092 | 17.21 | Gravel | 10 | 6½ | | | | | | | 30 | 60.00 | | | 5 | .56½ |
| Pershing | J. N. Lidford | 69,909 | 13.69 | Gravel | 10 | 6½ | | | | | | | 85 | 37.50 | | | 8 | .56½ |
| SOUTH CAROLINA | | | | | | | | | | | | | | | | | | |
| Greenwood | Rozier Rodgers Const. Co. | 13,163 | 197′ | Rock Asph. | 20 | 2 | | | | | 10 | 5.00 | 344 | 24.00 | 57,072 | .05 | 1 | .15 |
| Greenwood | C. C. Jordan | 52,702 | 7.81 | Top soil | | | | | 79,472 | .33 | | | 260 | 24.00 | 19,552 | .06 | 1 | .15 |
| Laurens | Newel Contracting Co. | 67,414 | 10.196 | Top Soil | 20 | 12 | | | 97,665 | .31 | 2,335 | 1.25 | 472 | 24.00 | 44,679 | .06 | 2 | .15 |
| Laurens | J. C. Morton & Co. | 8,722 | 132′ | Rock Asph. | 20 | 2 | | | | | 10 | 10.00 | 194 | 24.00 | 36,239 | .06 | .. | .... |
| TENNESSEE | | | | | | | | | | | | | | | | | | |
| Tipton | Little & Dean | 77,017 | ..... | Gr. & Dr. | | | | | 31,678 | .38 | | | 1,168 | 24.60 | 126,509 | .06 | 3 | .25 |
| Gibson | Ellis & Smeathers Cresop Bros. | 34,877 | 2.25 | Gr. & Dr. | | | | | 15,338 | .33 | | | 541 | 24.00 | 56,197 | .06 | 1½ | .25 |
| Madison | J. A. Peterson | 126,988 | 7.78 | Gr. & Dr. | | | | | 47,180 | .38 | | | 1,889 | 24.00 | 301,625 | .05 | 6 | .25 |
| Tipton | F. D. Harvey J. A. Perdue & Co. | 106,053 | 9.86 | Gr. & Dr. | | | | | 130,097 | .38 | | | 1,277 | 25.00 | | | 3 | .25 |
| WYOMING | | | | | | | | | | | | | | | | | | |
| Crook | R. L. Wylie | 3,992 | 10.089 | Bridge | | | | | 750 | .40 | | | | | | | | |
| Park | Herb. S. Crocker | 24,758 | 5.033 | Bridge | | | | | | | | | 550 | 37.00 | 53,300 | .06 | App. 3 | |
| Hot Springs | W. P. Rocoe | | 7.398 | Bridge | | | | | | | | | | | | | | |
| Teton | Hoth Bros. & Co. | 48,685 | 12.883 | Gr. & Dr. | | | | | 99,000 | .30 | 1,450 | 1.50 | 220 | 42.80 | 15,000 | .09 | 35 | |
| Natrona | Herb. S. Crocker Peppard & Fulton | 44,247 7,364 | ..... 8.507 | Bridges Gravel | 18 | 7 | 14,600 cu.yd. | 1.90 | 71,100 | .33 | 12,700 | 1.40 | | | | | 25 | |
| Natrona | Sprague & Nisley Peppard & Fulton | 85,410 5,602 | 3.449 | Gravel | 18 | 7 | 6,000 cu.yd. | 1.10 | 31,500 | .20 | 50 | 1.30 | 13 | 38.00* | | | | |
| Hot Springs | R. C. Martin Russell Kimball Eng. & Const. Co. | 23,307 63,051 | 1,401 | Concrete | 20 | 6 | 16,810 | 2.98 | 4,700 | 1.00 | | | | | | | 6 | |
| IOWA | | | | | | | | | | | | | | | | | | |
| Marshall | Anderson & Empie | 38,347 | 1.07 | Concrete | 20 | 8 | | | 6,769 | .78 | | | | | | | 3 | .40 |
| KANSAS | | | | | | | | | | | | | | | | | | |
| Sumner | G. W. Branch | 9,390 | 600′ | Concrete Bank Protection | | | | | 1,815 | .40 | | | | | 5,140 | .07 | 3½ | .35 |
| Johnson | Highway Const. Co. | 134,992 | 4.02 | Concrete | 18 | 9 | | | 27,413 | .45 | 2,187 | 1.85 | 473 | 19.00 | 40,212 | .05½ | 2.5 | .35 |
| MASS. | | | | | | | | | | | | | | | | | | |
| Bristol | Canedy Const. Co. | 236,742 | 3.465 | RCC | 20 | 8 | | | 17,885 | 1.25 | 890 | 6.60 | 200 | 40.00 | 353,555 | .04½ | 2 | .50 |
| MISSISSIPPI | | | | | | | | | | | | | | | | | | |
| Hinds | Jefferson Constr. Co. | 143,477 | 0.328 | Br. Conc. | 20 | | | | 4,500 | 1.25 | | | 2,836 | 30.20 | 506,250 | .04½ | ½ | .25 |
| PENNSYL. | | | | | | | | | | | | | | | | | | |
| Perry | Union Pac. Co. | 339,936 | 5.077 | R. C. | 18 | 9 | | | | | | | 307<br>25 | 38.40<br>24.00* | 60,505 | .10 | | .35 |

*1-3-6

## Employment Shows Drop

(Concluded from p. 363)

in September of 1915 and remained there and reached its height in June 1920. The decline at this time is the result of the business depression that came during the latter part of 1920 and continued into 1921. The lowest point was reached in January 1921. The line started to rise from that time and had an upward trend to the year 1923. The drop in 1924 is the result of the slump in business conditions during the present year but it does not reflect in its decline the conditions that are indicated through the years, 1921 and 1922.




# Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of August 7, the next, on September 4.

| Steel Products: | New York | Atlanta | Dallas | Chicago | Minneapolis | Denver | San Francisco | Seattle | Montreal |
|---|---|---|---|---|---|---|---|---|---|
| Structural shapes, 100 lb. | $3.34 | $3.80 | $4.20 | $3.10 | $3.35 | $4.00 | $3.40 | $3.35 | $4.20 |
| Structural rivets, 100 lb. | 3.75 | 4.35 | 4.90 | 3.50 | 3.75 | 4.65 | 5.00 | 3.75 | 6.00 |
| Reinforcing bars, ¾ in. up, 100 lb. | 3.24 | 3.30 | 3.38 | 3.00 | 3.25 | 3.87½ | 3.35 | 3.25 | 2.70 |
| Steel pipe, black, 2½ to 6 in. lap, discount | 44% | 54.2% | 43% | 53% | 55.05% | 36% | 36.80@49.10% | 45% | 47.43 |
| Cast-iron pipe, 6 in. and over, ton | 60.60@61.60 | 52.00 | 60.00 | 56.20@57.20 | —55.50 | 68.00 | —58.00 | 65.00 | 65.00 |
| **Concreting Material:** | | | | | | | | | |
| Cement without bags, bbl. | 2.50@2.60 | 2.35 | 2.05 | 2.20 | 2.42 | 2.84 | 2.61 | 2.90 | 1.80 |
| Gravel, ¾ in., cu.yd. | 1.75 | 1.90 | 2.38 | 2.75 | 1.85 | 1.90 | 2.15 | 1.50 | 1.25 |
| Sand, cu.yd. | 1.00 | 1.40 | 2.00 | 2.75 | 1.25 | 1.00 | 1.50 | 1.50 | 1.25 |
| Crushed stone, ¾ in., cu.yd. | 1.85 | 2.00 | 2.83 | 2.75 | 1.75 | 3.50 | 2.15 | 3.00 | 2.25 |
| **Miscellaneous:** | | | | | | | | | |
| Pine, 3x12 to 12x12, 20 ft. and under, M.ft. | 57.00 | 35.00 | 57.20 | —51.50 | 37.75 | 34.75 | 31.00 | 23.00 | 60.00 |
| Lime, finishing, hydrated, ton | 18.20 | 22.50 | 20.00 | 20.00 | 25.50 | 24.00 | 22.60 | 24.00 | 21.00 |
| Lime common, lump, per bbl. | 3.00@3.25 | 1.45 | 1.85 | 1.50 | 1.40 | 2.70 | 2.15 | 2.80 | 10.50 |
| Common brick, delivered, 1,000 | 18.15 | 11.00 | 14.10 | 12.00 | 13.00 | 12.00 | 15.50 | 15.00 | 17.50 |
| Hollow building tile, 4x12x12, per block | Not used | .10 | .11 | .089 | .08 | .085 | ..... | .11 | .12 |
| Hollow partition tile 4x12x12, per block | .1162 | .10 | .11 | .089 | ..... | .085 | .108 | .11 | .10 |
| Linseed oil, raw, 5 bbl. lots, gal. | +1.07 | 1.13 | 1.20 | 1.05 | 1.14 | 1.24 | +1.13 | 1.13 | 1.01 |
| **Common Labor:** | | | | | | | | | |
| Common labor, union, hour | .75 | .30 | ..... | .87½ | ..... | .50@.55 | .55 | .62½ | ..... |
| Common labor, non-union, hour | .... | .25 | .30@.50 | .82½ | .50@.55 | .35@.50 | .50 | .62½ | .30@.35 |

**Explanation of Prices**—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 and 5 per cent.

**New York** quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅜c.; building laborers (pick and shovel men) 75c. per hr.

**Chicago** quotes hydrated lime in 50-lb. bags; lump finishing lime per 180-lb. net. Lumber delivered on job.

**Minneapolis** quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

**Denver** quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

**Atlanta** quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

**Dallas** quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

**San Francisco** quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

**Seattle** quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

**Montreal** quotes on pine lumber. Sand stone, gravel and lump lime per ton. Stone, lime and tile are delivered; sand, gravel and cement on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at par). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in. $119.

## Conditions Affecting the Market

Price weakness continues in such items as c.-i. pipe and pine timbers. The recent increase in steel mill operations and firmness in pig iron prices, however, may shortly affect the market.

Telegraphic reports to *Engineering News-Record* from the West coast, state that while lumber prices have declined in San Francisco, there is a slight upward tendency in the Seattle district.

Lumber demand is lighter, particularly in shortleaf pine timbers and dimension stock. In Chicago, however, the price of 3x12 pine timber dropped considerably, while 1 and 2-in. boards are in stronger demand.

The principal factors in this week's price line-up are linseed oil and lead. These indicate the paint demand. Lead advanced ⅜c. per lb. for both white and red and linseed oil rose 2c. per gal. in New York, effective Aug. 20. A more abrupt rise occurred in linseed oil in San Francisco during the week.

General firmness is reported in gravel and other concrete aggregates in the New York market, although prices remain firm at Aug. 7 levels.

The iron and steel situation is briefly described as follows: Pig-iron production increasing gradually; quotations unchanged from last week. Iron demand slight although inquiries are numerous. Weakness continues in market for heavy rolled products, particularly plates. More of a tendency is being shown at present to purchase for replenishment of steel warehouse stocks. There is active inquiry for rails and car material. Quotations on principal hot-rolled products, follow: Reinforcing bars, $2.10@$2.15; shapes, $1.95@$2.15 and plates, $1.75@$2 per 100 lb., Pittsburgh.